SCIENTIFIC AMERICAN

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WEEKLY.

A NEW OPTICAL LANTERN.

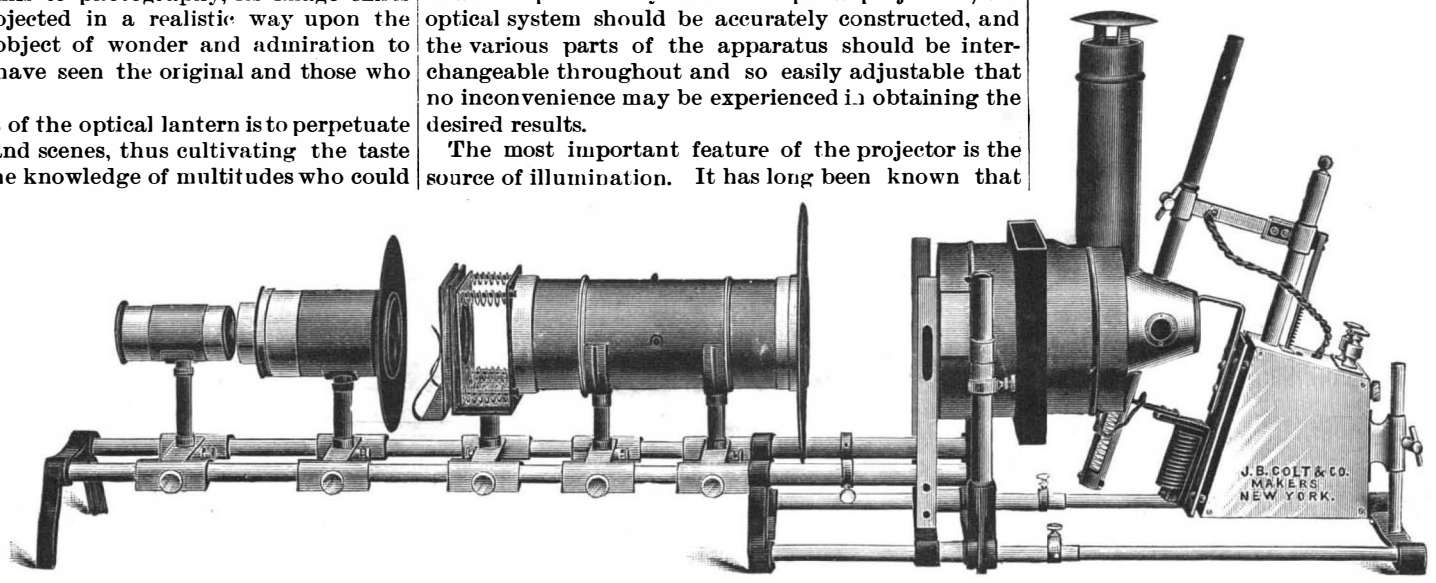
The beautiful Peristyle which excited the admiration of millions during the summer has passed away in smoke; but, thanks to photography, its image exists and may be projected in a realistic way upon the screen, still an object of wonder and admiration to both those who have seen the original and those who have not.

One of the uses of the optical lantern is to perpetuate beautiful forms and scenes, thus cultivating the taste and increasing the knowledge of multitudes who could never have seen the object themselves. With greater perfection comes greater usefulness, so that improvements in photography, in conjunction with improvements in the optical lantern, yield results which a few years ago were not regarded as among the possibilities.

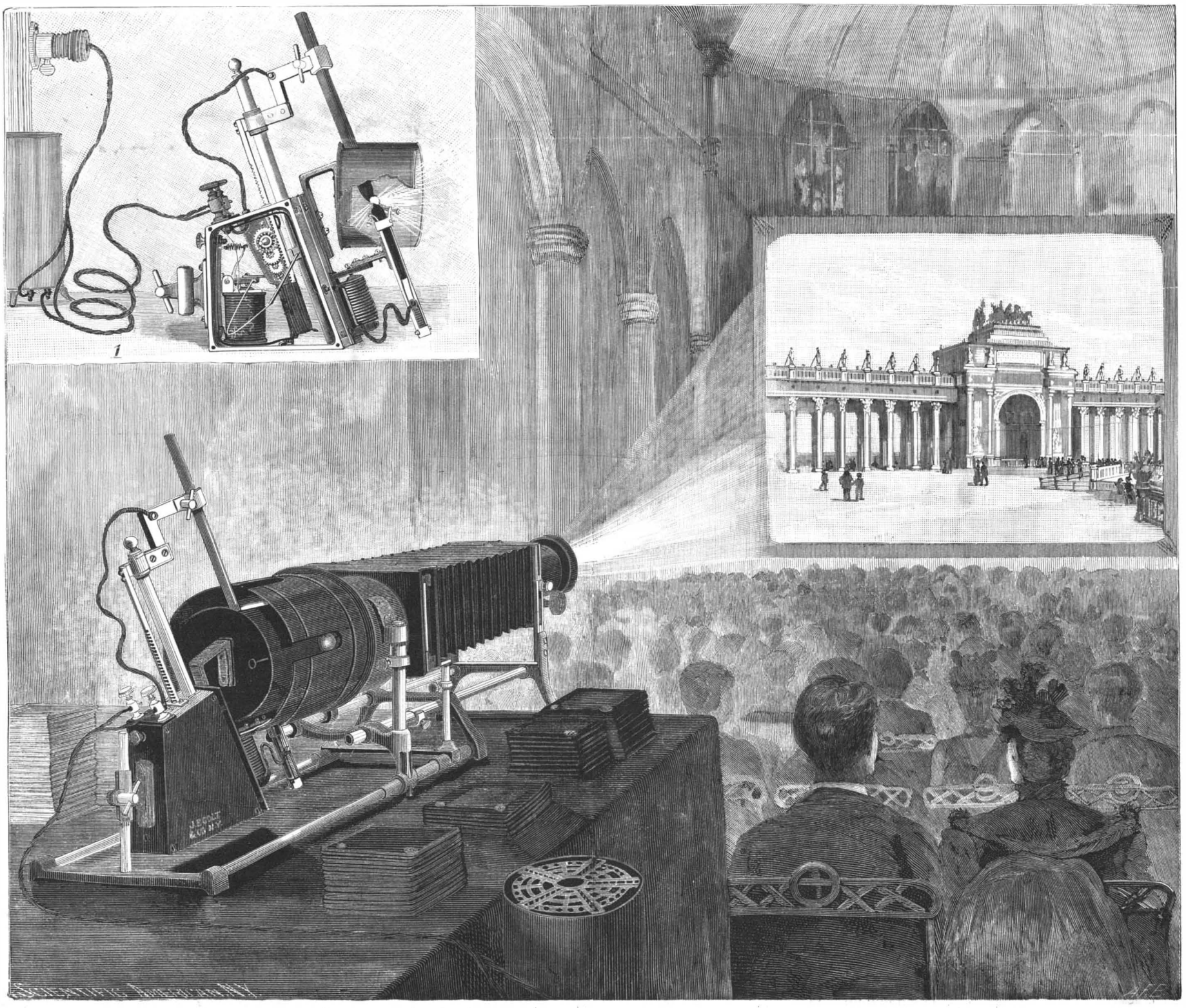
To perform satisfactorily the great variety of demonstrations possible by means of optical projection, the optical system should be accurately constructed, and the various parts of the apparatus should be interchangeable throughout and so easily adjustable that no inconvenience may be experienced in obtaining the desired results.

The most important feature of the projector is the source of illumination. It has long been known that the electric arc light, owing to its intensity and whiteness, and to the fact that it is confined approximately to a "point," affords the most desirable form of radiant; but, owing to irregularity in the consumption of the carbons and the difficulty of maintaining the arc in a permanent position, it has not been generally adopted for projection purposes. In the form of lamp here shown, which is manufactured by J. B. Colt & Co., of 16 Beekman Street, New

(*Continued on page 40.*)



LANTERN WITH OPTICAL BENCH—SHOWING POLARISCOPE.



NEW OPTICAL LANTERN AND ELECTRIC LAMP.

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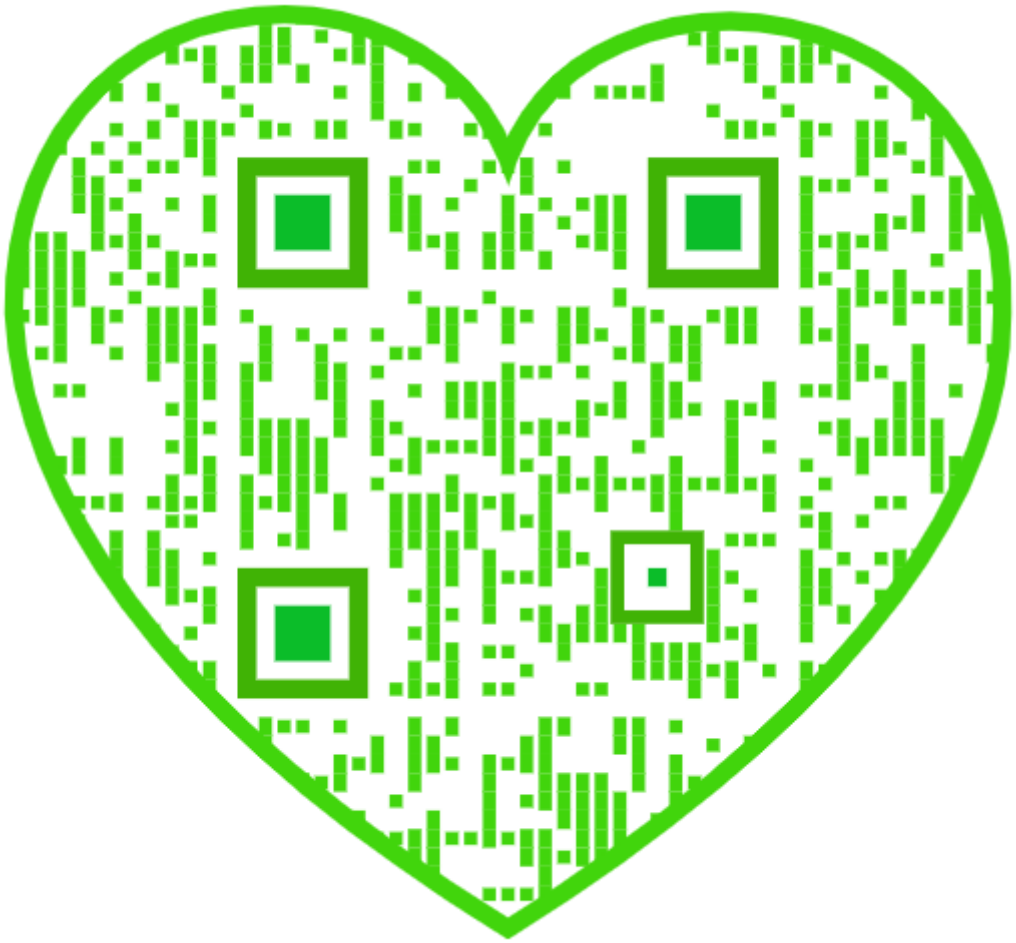

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THE POTENTIALITIES OF CHEMICAL RESEARCH.

The men of brains—the leaders in the progress of our race—have of late become so wrapped up in one comparatively narrow branch of science, the mechanics and dynamics of electricity, that there has unquestionably been a growing neglect of the greatest and most universal, the most practical and fertile, the most far-reaching and civilizing of all the sciences. A science, moreover, which is scarcely older than that of electricity, that is, one which emerged but little earlier from the swaddling clothes of empiricism. Nevertheless, the young giant, chemistry—of which we speak—has a future before it which involves that of the race of man more intimately and more completely than all the other sciences combined.

Those who pursue electricity, by the inductive method—that of practical experiment and generalization therefrom—have lately entered the complaint that electricity has become nine-tenths mathematics. In a certain sense, this may be all right, but it is not the way in which electricity itself was founded. The men of the laboratory laid its foundation; and it may be asserted that it is still in the experimental laboratory that all the new fundamental facts are and will be born. Mathematics is not a discoverer, though a highly valuable expounder. To many real experimental discoverers, the higher branches of mathematics constitute a trackless maze. Indeed, the peculiar brain powers needed by the expert mathematician resemble those of the musical composer, and the methods of each require the same constant and assiduous cultivation, memorization, practice, mental absorption and abstraction, which together make up that rare combination called "genius."

There is no doubt that in America experimental chemical research has but a slight foothold. The causes are on the surface, and easily understood, but are outside our present scope. It is proposed here to show cause for the conviction, in reasoning minds, that the prospects of our race—some already in sight—depend mainly on the cultivation of experimental, analytical and synthetical chemistry.

First, to present a generalization or induction from the whole field of chemical research. Much of such research has been, is and will yet be, pervaded with what may be called the *random* element. All experimental attempts to penetrate the unknown necessarily partake of this element. It is only when facts have so multiplied as to render *generalization* possible that *systematic* research begins. The great amount of more or less random research yet prevailing proves that chemistry is as yet but an infant, destined to a gigantic growth—a growth in fact illimitable.

We now know with certainty 72 elements of matter. Each one of these is—according to the results of research—the basis of an incalculable number of compounds, no two of which are exactly alike in any one of their relations to other bodies. The changes to be rung on nine bells, or even on nine thousand, are but a drop of water to the ocean, compared with the possible variety of chemical bodies, each possessing certain salient potencies, which are to be found only by experiment, and can rarely be predicted. The number of chemical species or forms of matter, each distinct from all others, is therefore *practically* infinite. The generalization based on this is as follows: A form of matter must be capable of existence, and must, therefore, be within the power of chemical research to discover and prepare, which will possess *any assignable or conceivable potency*, or influence over any given species of matter, dead or living.

If we have here been successful in shaping a form of words so as to make this general induction clear, the results that proceed therefrom will quickly present themselves to any rational mind.

Here, and now, we can only comment on one deduction therefrom. This relates to a new subject which, though of a vital importance to mankind beyond the power of words to convey, is yet in a condition of incipiency—scarcely half born. We might call it chemical pathology—the chemistry of diseases. It relates to the chemical *nature*, *origin* and *cure* of diseases. We are, by dint of numerous random investigations, made mainly in this, our century, beginning to see quite plainly a new induction, which will doubtless form the cornerstone of this new branch of experimental chemical research. The "germ theory" of diseases has gone through long controversies. It has been but quite recently recognized, however, that the germs themselves and their living progeny do not constitute the diseases, and are not even the *immediate* agents, generally speaking, of such diseases. It is now becoming a matter of belief that in some (and of strong suspicion that in almost, if not quite all) of this class of diseases, it is the distribution throughout the circulation of the animal, of specific poisons, similar to snake poisons, products of the conversion or rather *perversion* of vital tissues by the progeny of the disease germs, that constitutes these diseases. The ancients said: "Fas est ab hoste doceri." (It is right to be taught by your enemy.) This applies here. Now that we know that the enemies born from the disease germs kill us by poisoning our blood—if we cannot deal with these enemies directly, we may destroy, or neutralize, or paralyze their weapons. The next step is for the chemist to discover, analyze, and experiment upon these specific poisons—these *tox-albumens*, or *ptomaines*, or whatever they may prove to be—and discover how to destroy them, or combat them with antidotes.

According to the generalization propounded above, such antidotes—and, moreover, we may add, chemical compounds capable of poisoning or dislodging the disease fungoids themselves—must be susceptible of existence, and will sooner or later be discovered. No nobler aim than this could animate a chemist. The prospect is plain that all these hitherto invisible and inscrutable foes of our race will yet be disarmed and defeated by the weapons of the chemical laboratory. Life will then be prolonged, and our vital energies enhanced.

Artificial Coloring of Flowers and Fruit.

The tinting of flowers naturally white has already been spoken of in these pages, and now we have a little more to tell our readers about the same subject. It seems only natural that so purely fanciful an art should originate among our French neighbors, whose ingenuity is so well known. The *Revue Horticole* tells us a few of the secrets of the production of color in flowers and fruit, and we mention them here for the benefit of any who may wish to try such a curious experiment for themselves. It is said that to color flowers through the stalks, it is necessary to put five grammes (1 gramme=15 grains) of any coloring matter into a vessel which will hold about ten grammes, to bruise the tip of the cut stalk with a light tap with a hammer, and then to put the stalk into the vase for a greater or shorter time, according to the depth of coloring required. Two hours after this contact with the dye the tinting of the flower is accomplished. On taking the blossom from the vase, it is advisable to cut off the bruised part of the stalk and soak the flower for an hour or two in a vase of clear water. To tint white bulbous plants, fill a vase with fifty grammes of clear water and fifty grammes of coloring matter, stir the mixture up well, then, after slicing the bulb with a penknife in one or two places and cutting off the tips of the roots, leave it steeping in the tincture until the flowers begin to color. Then replace it in the pot, covering it with a little moist earth, and the flowers will finish coloring there. Fruits as well as flowers can be artifically colored, and sometimes this is done for the purposes of adulteration, as, for instance, when plums are too green they are coated with acetate of copper and sulphate of copper. When too pale, lemons are tinted up with citronine and "naphtol yellow," the green spots being imitated with "diamond green." Strawberries are colored by sprinkling them with "sulfo-fuchsine" or "rhodamine." Peaches receive a beautiful coloring from a mixture of "rhodamine" and "citronine," applied with a brush, using a zinc stencil plate pierced with holes. In melons a tube is introduced through which "atropeoline" and "orange azo" with a little essence of melon is put into the center. Very pretty varieties of apples and pears are contrived by using a little aniline dye. These devices may make bad fruit salable, but are not examples to be copied, unless for the sake of making a curious experiment.—*The Gardeners' Chronicle.*

Honors to the Memory of Tyndall.

At a special general meeting, Friday, December 15, 1893, of the Royal Institution of Great Britain, Sir James Crichton Browne, M.D., LL.D., F.R.S., treasurer and vice-president, in the chair, the following resolution, in reference to the decease of Dr. John Tyndall, honorary professor of natural philosophy of the institution, was read and unanimously adopted:

Resolved, That the members of the Royal Institution of Great Britain, in special general meeting assembled, hereby record their deep regret at the death of Dr. John Tyndall, D.C.L, LL.D., F.R.S., who was for forty years connected with the institution as lecturer, professor, and honorary professor of natural philosophy, and who, by his brilliant abilities and laborious researches, has nobly promoted the objects of the institution, and conspicuously enhanced its reputation, while at the same time he extended scientific truth and rendered many new additions to natural knowledge practically available for the service of mankind; and that the members of the Royal Institution further desire to convey to Mrs. Tyndall an expression of their sincere sympathy and condolence with her in the bereavement she has sustained in the loss of her gifted and distinguished husband.

Fire Losses of 1893.

During the year just ended the loss by fire in the United States in property value was almost $150,000,000, a greater loss than has been recorded in any one year, except that in which Chicago was burned, and that in which the best part of Boston was blotted out. Boston lost more last year than any other city, the estimate being $5,300,000. Nearly the whole of it fell upon the insurance companies.

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The Turlock and Modesto Dam.

The completion of the Turlock and Modesto irrigation dam gives California the largest and highest overflow dam in the world.

The contract for the great structure was let in June, 1891, and although two years and a half have elapsed, the preliminaries, and the months lost by reason of high water, reduce the actual working time to fourteen months, during which period 150 men—all white – were employed.

It will be readily appreciated that the preliminary work, including the diverting of the waters of the Tuolumne River by means of flumes, and the excavation to bedrock for the base, was a task of no small magnitude. Added to this was the necessity for lowering the machinery employed, including nine donkey and stationary engines, from the summit of a hill towering above the scene of operations on the hillside and in the river bed. All the supplies, too, were handled in this manner.

The dam, it should be premised, is situated on the Tuolumne River, where that stream foams through a canyon in the foothills of the Sierra Nevada range of mountains, a mile and three-quarters above the old mining town of La Grange and about thirty-three miles east of Modesto. The ragged, mountainous hills that tower on either side are of blue trap formation, covered by a scanty soil, and at the site of the dam the conformation is such that the masonry laid by the builders interlocks with and is supported by the hillsides.

The original plans of the dam were approved by Colonel Mendell, the noted civil engineer, and have been followed without material change. It is constructed on the principle of an arch, on a radius of 300 feet; hence its surface length on the top is 336 feet, while a straight line drawn from bank to bank would be but 317 feet in length. Its base is 70 feet in length and 97 feet through, sloping upward on the lower side at a ratio of 4·67 feet in ten feet, so that at a height eleven feet from the top, from which point it is rounded to carry the overflow water down the slope, its breadth diminishes to 24 feet. The upper wall is perpendicular, and both upper and lower walls are of shaped rock laid in cement mortar.

Embraced in this stupendous structure are approximately 40,000 cubic yards of rubble masonry. Over 31,000 barrels of cement, each weighing 400 pounds, entered into its construction. The center of the dam, between the face walls, is comprised of great masses of blue trap, embedded in concrete, the interstices filled with smaller rock and concrete, and the whole thoroughly rammed. The rock is the blue trap of the country, blasted from quarries opened near the spot, drawn up an inclined railway, and conveyed to the spot required by a system of elevated cable tramways. The concrete used is composed of a mixture of twenty-two cubic feet of broken rock, eight cubic feet of sand and one barrel of cement, washed and mixed in a revolving mixer operated by steam, and conveyed to the dam by the cable tramways.

Two sand-ways are provided for in the dam, but the water not taken out by the canals is to go over the top and down the inclined lower wall to the bed of the stream, impinging first on the "leg" of the structure, which, of rubble masonry, extends out some distance and obviates all possibility of undermining.

A great reservoir is formed by the dam, the water of the river backing up for three miles. This winter and next spring, at times of freshets, a volume of water ranging from five to twenty feet in depth will pour over the structure.

The cost to the districts of this most essential factor in the irrigation enterprise ranges from $525,000 to $550,000, equally divided. The main canals designed to carry the water to the irrigation districts are well advanced, and have a carrying capacity estimated to be sufficient to give an average of one foot of water for every quarter-section embraced in the 257,000 acres comprising the two districts. While the advantages to accure from the use of the water in this direction overshadow all others, the fact that there exists great possibilities for the generation of power, to be transmitted through the medium of electricity, has not been lost sight of.—*Pacific Lumberman.*

The Earth's Motion Made Visible.

In the December issue of *Popular Astronomy*, Eliza A. Bowen shows how the earth's *revolution* may be made manifest to the eye. Dr. L. Swift, in *Popular Astronomy*, says: Place on the floor of a room free from tremors and air currents a good sized bowl nearly filled with water and sprinkle over the surface of the water an even coat of lycopodium powder, and across this make a narrow black line of pulverized charcoal. Place the bowl so that the black line shall coincide with a crack in the floor, or, if the room be carpeted, lay a stick upon the floor exactly parallel with the mark. After a few hours it will be found that the line is no longer parallel with the stationary object, but has moved from east to west, proving that, during this interval, the earth has moved from west to east.

The reason appears to me to be that the solid floor has with the earth and bowl moved from west to east, and so has the water also, but at a slower rate, as there is a slight inertia, of which the yielding liquid does not instantly partake, to be overcome. It will be seen that the line or charcoal mark always moved from east to west.

Artificial Silk.

A writer in the *Petit Journal*, says the *Mediterranean Naturalist*, gives an interesting account of a new industry which has just been started at Besancon, in France, where wood pulp is converted into soft silken thread.

"I am going to tell you about the most astonishing thing, the most surprising, the most marvelous, the most miraculous, the most triumphant, the most astounding, the most extraordinary, the most incredible, the most unexpected, the most prodigious, the most unique, the most brilliant and the most worthy of imitation and envy of this century—it is the invention of Count de Chardonnet, by means of which wood pulp or cotton is converted into durable, luminous and elastic silk."

For a long time after its discovery the process and system of M. de Chardonnet remained concealed in his laboratory. It made its first appearance at the Exposition of 1889, where it received the highest award that the jury could give. Connoisseurs, savants and manufacturers were greatly interested in it, though it had not reached the degree of perfection to which it has been brought to-day.

The great question, that which leads all others since the new invention tends to produce a revolution in one of the greatest of French industries, is, Can this discovery be utilized for the growing needs of the people?

A complete answer in the affirmative has been given to-day by M. de Chardonnet, who has already, by enlisting the sympathies of several business men, built a mill at Besancon, where the "silk" is being manufactured. Raw material is made from wood pulp, such as is used for the fabrication of certain kinds of paper. This pulp is carefully dried in an oven and plunged into a mixture of sulphuric and nitric acids, then washed in several water baths, and dried by alcohol.

The product thus prepared is dissolved in ether and pure alcohol, and the result is collodion, similar to that used in photography. This collodion, which is sticky and viscous, is inclosed in a solid receptacle, furnished with a filter in the lower end. An air pump sends compressed air into the receptacle, and by its pressure the collodion is passed through it horizontally. This tube is armed with 300 cocks, of which the spouts are made of glass, and pierced by a small hole in the diameter of the thread of a cocoon as it is spun by the silkworm.

The spinner opens the cock, and the collodion issues in a thread of extreme delicacy (it takes six to make a thread of the necessary consistence for weaving). This thread is not, however, fit to be rolled on spools by reason of its viscosity and softness. The matter is yet as collodion, and not silk. To produce the necessary hardness the inventor resorted to a very ingenious but simple method. The little glass tube already mentioned is surrounded by a small reservoir of the same material constantly filled with water; when the thread issues from the aperture in the manner described, it traverses this water, which takes up the ether and alcohol, and the collodion becomes solidified, that is to say, it is transformed into an elastic thread, as resisting and brilliant as ordinary silk.

One more detail. On account of the materials employed in the manufacture of this silk—wood ether and alcohol—it might be rightly supposed, as was mentioned in the former report, that the stuff manufactured would be dangerously inflammable. M. de Chardonnet has apparently obviated such a contingency by plunging the spun thread in a solution of ammonia, thus rendering it as slow of combustion as any other material.

Another practical difficulty to be remedied in the invention is the frequent snapping of the slender threads issuing from the cylinder by reason of unequal pressure. This makes it impossible to maintain a standard quality for the output, and, consequently, there may be produced five pounds of excellent silk followed by five pounds of a comparatively worthless quality. This difficulty is being overcome, but until it is completely removed men of large means will not invest largely in the stock of the company which has been formed to exploit Count Chardonnet's invention.

Up to the present time none of the rich and important silk men of St. Etienne and Lyons have invested heavily in this enterprise. They all profess to believe in it, and declare that in a few years artificial silk produced by this process, when it shall have been somewhat improved in certain details, is destined to figure largely in the commercial world.

The disposition to-day on the part of French capitalists is to await developments. When the process is once perfected, and its results are wholly satisfactory, there will be a lively struggle for the control of this valuable invention, and there seems to be no doubt of the ability of the inventor to remove every obstacle which stands in the way of perfect, practical success.

The Minneapolis Flour Mills.

The annual report of the Pillsbury-Washburn Flour Mills Company, presented to that corporation in London, November 14, shows that the past year has been unfavorable, so far as profits are concerned, owing to the fall in the price of wheat and flour, the decline being about 40 per cent. The following exhibit shows the consumption and production for the past three years:

	Flour produced, barrels.	Wheat ground, bushels.
"A" Mill	1,482,000	6,443,000
"B" Mill	855,300	3,692,000
Anchor Mill	445,200	1,926,000
Palisade Mill	577,400	2,506,720
Lincoln Mill	237,500	1,024,000
Total, 1893	3,597,400	15,591,720
" 1892	3,776,500	16,234,848
" 1891	2,827,800	12,456,000

The yields for the different years, commencing with 1891, have been 4·22, 4·18, and 4·20 respectively, and the best yield for 1893, it will be noticed, was accomplished in the smallest mill, while the "A" mill figures out the largest amount of wheat used for a barrel of flour. The profits, it will be seen, net something under 4½ cents per barrel, but, if wheat has touched bottom, it was declared that the company was in the very best position to make money in the future. Mr. Pillsbury's management of the company's affairs in Minneapolis was warmly indorsed by the directors, his whole-souled devotion and loyalty to the interests of the concern being applauded by a unanimous vote.

The Deepest Metal Mine in the World.

The United States has now, we believe, the deepest metal mine in the world. For some time that claim has been made for the Maria shaft, at the mines of Przibram, in Austria, which was 3,675 ft. below the surface at the time of the great fire in 1892; and nothing, we believe, has been done upon it since that time. It has now been surpassed in depth by the No. 3 shaft of the Tamarack Copper Mining Company, in Michigan, which on December 1st was 3,640 ft. deep, and is now more than 3,700 ft., the average rate of sinking being about 75 ft. a month. This makes it beyond question the deepest metal mine in existence, and only one other shaft has reached a greater depth, that of a coal mine in Belgium, for which 3,900 ft. is claimed.

For the attainment of this distinction we have to congratulate Captain John Daniels, the general manager of the company, for the skill and success with which the work has been carried on. In Germany the completion of the Adalbert shaft to a depth of 1,000 meters (3,281 ft.) was thought worthy to be the occasion of a public festival; and though the Tamarack shaft has been carried down to the present great depth entirely as a matter of business, and no especial formalities have marked its progress, the remarkable achievement certainly deserves recognition, for not only has it been sunk to a greater depth than any before it, but it has been sunk with much greater rapidity and at a less cost than probably any European shaft of anything like its depth or in ground as hard.—*Eng. and Min. Jour.*

A Twelve Mile Gun.

In a paper read before the Western Society of Engineers, Captain W. H. Jaques says:

"The wire-wrapped type had the honor of firing the 'Jubilee Rounds' in the Queen's Jubilee year, and gave wonderful results. On April 16, 1888, was fired at Shoeburyness the first of a series of rounds intended to investigate the conditions attending firing at very long ranges. The gun selected was a 9·2 gun, made under the direction of General Maitland in the Royal Gun Factories. The weight of the gun was 22 tons, that of the projectile 380 pounds, which, fired with a charge of 270 pounds, gave a muzzle velocity of 2,360 foot seconds. The elevation of the first round was 40°. The projectile fell at a range of about 21,000 yards, or nearly 12 miles. On July 12, at 43° elevation, a range of 21,600 yards was attained, and on July 26, with 45° elevation, the range was 21,600 yards, or about 12·4 miles. The projectile remained in the air about 69·6 seconds, and its trajectory reached a height of 17,000 feet, or about 2,000 feet higher than the summit of Mont Blanc."

How to Mend Crockery.

A valued correspondent says: Before being allowed to get dirty or greasy tie all the broken pieces in their places nicely with any kind of string that suits, then put in an iron or tin dish that can be put on the fire, pour in as much milk as will cover the fractures well, put on the fire and boil for say ten minutes, and the whole operation is complete. Don't undo the wrapping until the dish is completely cold, and if yours hold at ours do, you will call it a success.

A SUBSCRIBER.

THE longest reach of railway without a curve is claimed to be that of the new Argentine Pacific Railway from Buenos Ayres to the foot of the Andes. For 211 miles it is without a curve, and has no cutting or embankment deeper than two or three feet.

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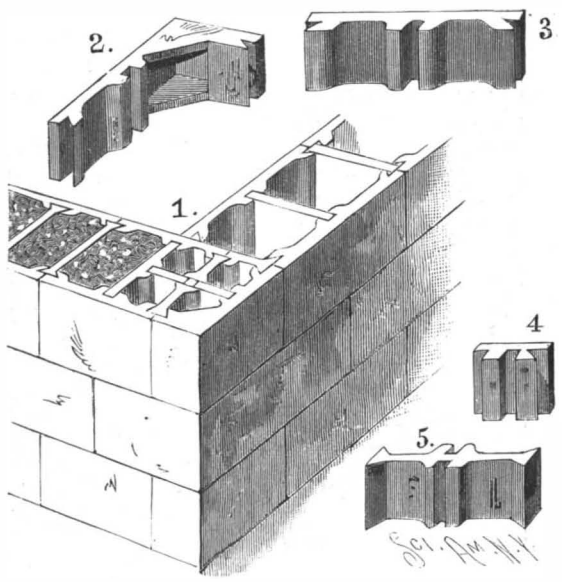
AN IMPROVED BUILDING TILE.

This is a very cheap building material, of which the parts may be easily moulded and the assembled tiles rapidly laid. The improvement has been patented by Mr. John Stewart, Jr., of Somersworth, N. H. Fig. 1 shows the improved tiles in place in a wall, a portion of which is filled in with concrete and provided with air spaces, Fig. 2 showing a corner piece, Figs. 3 and 4 side pieces, and Fig. 5 a cross partition and brace. The side pieces have on their inner sides ribs with inwardly inclined edges, to receive the dovetail heads or keys on the ends of cross tie pieces, and vertical parallel ribs to receive cross braces. To strengthen the corner



STEWART'S TILE BUILDING WALL.

piece, it has horizontal flanges or braces at the junction of the side and end, and an additional tie bar or brace extends parallel with the corner piece. For making half tiles, such as may be used in squaring up next the frames of windows, etc., a small side piece is used, as shown in Fig. 4. These tiles are substantially as strong as the usual hollow tiles, are proof against the depredations of vermin, and may be made to keep the interior of a building perfectly dry. The outside wall may be terra cotta or glazed tile, and the inside papered, painted, etc., or roughened for plaster, no studding or lathing being required.

SPECIAL TRIPLE GEARED LATHE.

This lathe has been specially designed for turning marine propeller shafts and heavy general work. We are indebted to the *Engineer*, London, for our illustration and the following particulars: The height of the centers is 30 in., and it admits 40 ft. between the centers. The driving is effected through five speed cones direct onto the face plate, and two series of double and triple gear, giving twenty-five speeds to the spindle, all properly graduated to suit the different diameters admitted by this lathe. There are two saddles, each having a set of duplex compound slide rests; and there is also a compound slide rest on the loose headstock for turning the coupling flanges, so that five tools can be in operation simultaneously. The front slide rests are fitted with swivels for taper work. Further, each saddle is so fitted that by means of change wheels, tapers of any length and inclination can be automatically turned, this arrangement being of great convenience for turning the tapered ends of propeller shafts, gun tubes and similar work. The saddles and loose headstock can be rapidly adjusted on the bed by power motion, and throughout every convenience is provided for quickly manipulating the various motions in the lathe.

In all respects this machine is throughout of the most massive character, and it has been specially designed to take heaviest cuts possible. Its weight is about 60 tons.

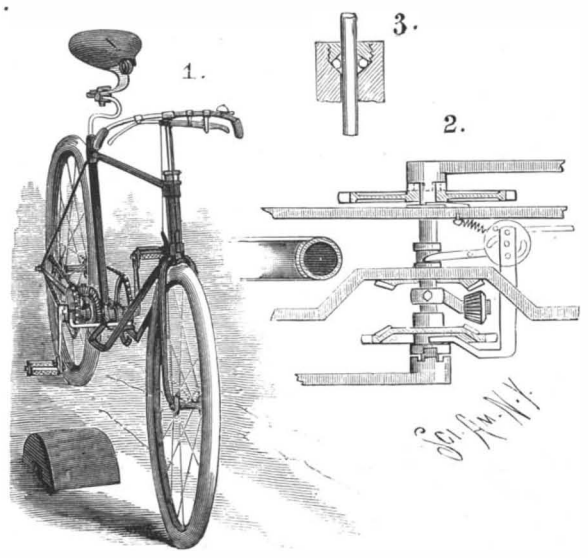
The lathe was recently made by Messrs. Sharp, Stewart & Co., Atlas Works, Glasgow.

Molasses and Petroleum.

Almost all the molasses which comes from Cuba to the United States is brought in the same tanks in steamships that are used to carry petroleum as a return cargo. The ships' tanks are about sixteen feet deep and have a neck seven feet deep. They are pumped full of oil at Brooklyn or Philadelphia, then taken to Havana, and the oil is pumped out into the tanks of the refining plants there. Molasses is brought from the interior of the island in huge hogsheads, which are emptied into the storage tanks. A suction pump drawing about 10,000 gallons an hour fills each ship's tanks to within about two feet of the top, that amount of space being required for the expansion of the molasses. It might be supposed that the petroleum would have a bad effect on the molasses, but it has been shown that the contrary is the case, and as nearly one-half the importation is made into rum and the balance refined into sugar, a little oil is not of much account. The tanks are cleaned after the molasses has been pumped out by turning in a powerful steam jet, which washes down the sides and liquefies whatever molasses may be left in the bottom of the tank, and the suction pump finishes the work. A cargo of molasses, which formerly required ten or twelve days, can now be unloaded in forty-eight hours, while the difference in cost of handling, to say nothing of the saving of time, amounts to a large sum. Since the present system of dividing a vessel's hold into tanks was devised and put in practice on steamers the profits of the trade and the steamship companies have largely increased.—*N. Y. Tribune.*

AN IMPROVED BICYCLE DRIVING GEAR.

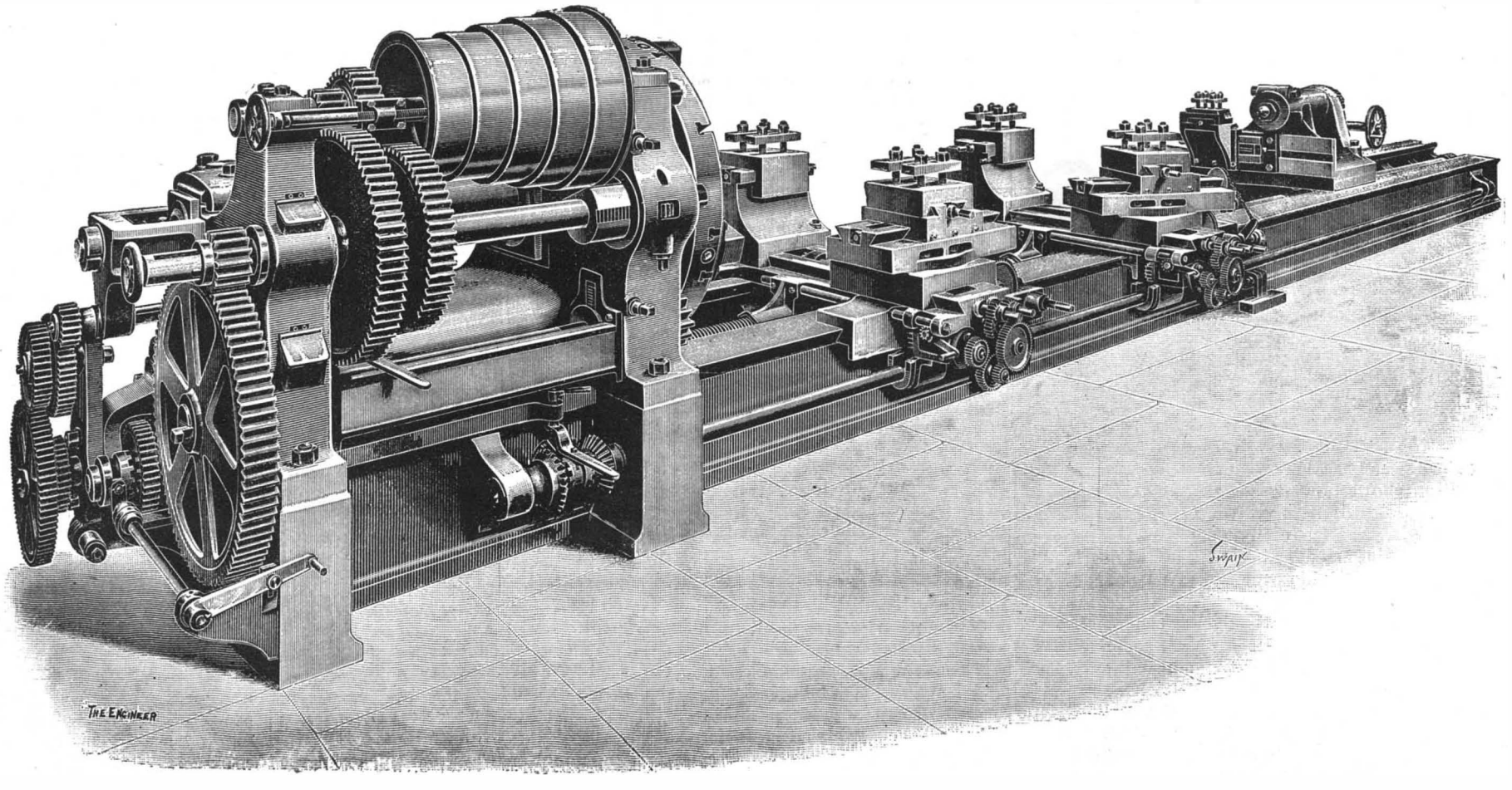
This is a simple and convenient differential gear mechanism for application to an ordinary safety wheel, to change at will the speed and power of the machine without dismounting. The improvement has been patented by Messrs. George B. Robinson and William R. Roby, of Colorado Springs, Col. Fig. 1 shows a bicycle provided with the improved gear, Fig. 2 being a sectional plan of the gear, and Fig. 3 illustrating one of the ball bearings of the pedal shaft. The lower portion of the frame is provided with a brace having an inwardly bent portion in which slides and rotates the pedal shaft, the cranks of which have at their inner ends hubs secured to the shaft, these hubs having on their inner faces clutch teeth adapted to engage sprocket wheels of two sizes on opposite ends of the pedal shaft. One of these wheels has on its inner side a beveled gear adapted to engage a pinion journaled on the free end of an arm secured to the shaft, the pinion also engaging a beveled gear wheel fixed to the bent portion of the brace, so that when the shaft is revolved and the pinion is in mesh with the gear it has a movement around the shaft and also turns rapidly on its own axis by reason of the contact with the gear wheel. When the pinion, therefore, is in engagement with both the gear wheels it has a greatly accelerated movement,



ROBINSON & ROBY'S BICYCLE.

causing one of the spocket wheels to turn twice to every revolution of the pedal shaft. The machine has two drive chains, one connecting with the larger sprocket wheel on one end of the hub, and the other with the smaller wheel on the other end, and the changes from one gear to another are effected by means of a lever fulcrumed on the handle bar, the latter being provided with three hooks, one above another, and the placing of the lever in either of the three positions effecting a corresponding change of the gear. With the lever resting in the lower hook, the machine has the normal speed; for a slower speed and greater power, as in going up hill, etc., the lever is lifted into the second hook, while, when great speed is required, the lever is lifted into the third hook, all the changes being made without dismounting and without materially slackening the speed of the machine. Fig. 3 shows the ball bearing of the pedal shaft, which has a longitudinal movement, The gear mechanism is preferably covered by guards secured to the frame and brace, one of these guards, as shown in Fig. 1, lying under the machine.

THE forced draught or the supply of air under pressure to steam boilers was the original invention of the late Edwin A. Stevens, of Hoboken, N. J., and was patented by him April 1, 1842.



IMPROVED TRIPLE GEARED LATHE.

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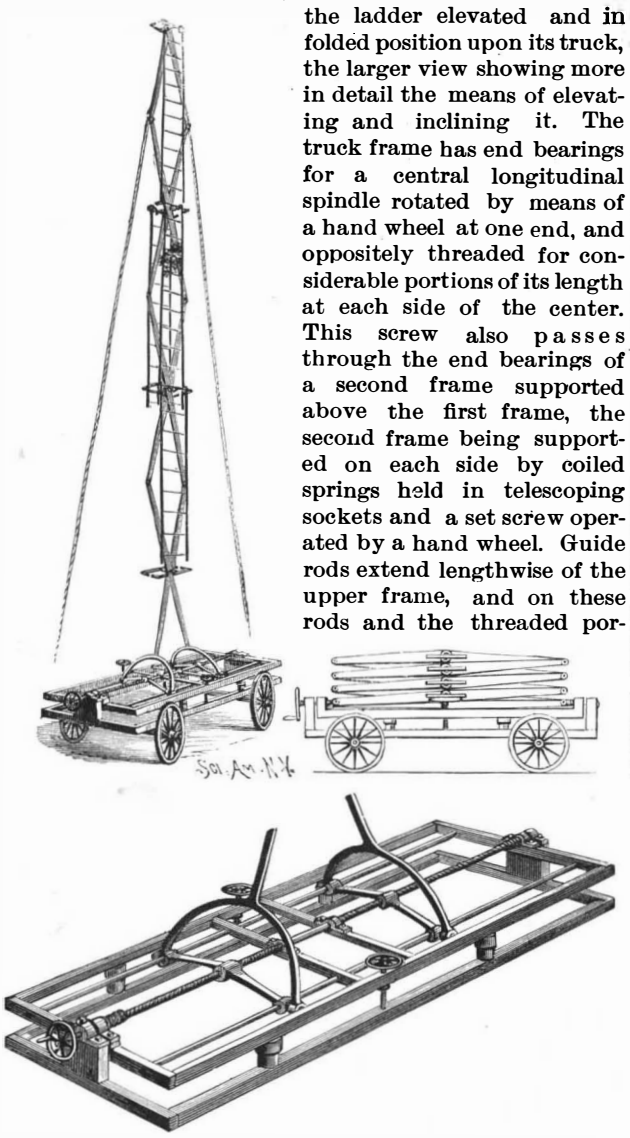
AN IMPROVED FIRE LADDER.

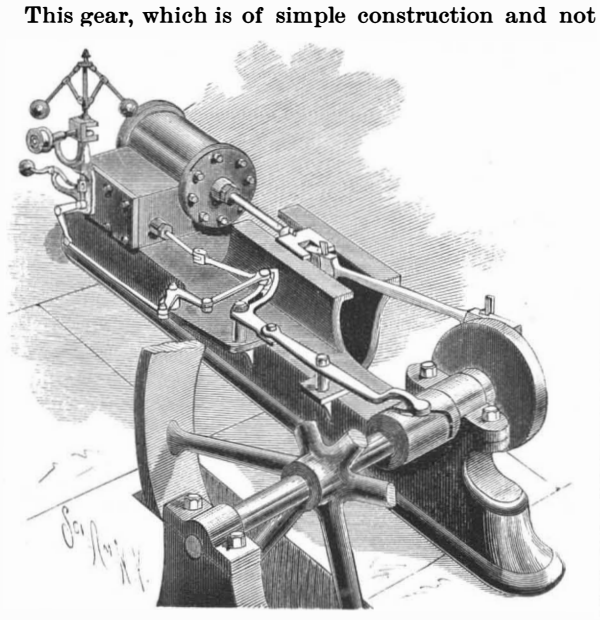
A fire ladder which may be conveniently folded upon a truck and readily elevated to a considerable height, while being adjustable to various inclinations as desired, has been patented by Mr. David B. McHenry, of Grenada, Miss. The illustration shows the ladder elevated and in folded position upon its truck, the larger view showing more in detail the means of elevating and inclining it. The truck frame has end bearings for a central longitudinal spindle rotated by means of a hand wheel at one end, and oppositely threaded for considerable portions of its length at each side of the center. This screw also passes through the end bearings of a second frame supported above the first frame, the second frame being supported on each side by coiled springs held in telescoping sockets and a set screw operated by a hand wheel. Guide rods extend lengthwise of the upper frame, and on these rods and the threaded portions of the central spindle travel two cross bars or bridges having threaded sockets engaging the threads of the spindle. To the outer ends of these cross bars are pivotally connected the arched lower members of a set of lazy tongs, and the pivots of these lazy tongs are formed with T-shaped extensions, between the ends of which ladder sections may be hung by means of hooks. By turning the hand wheel at the end of the frame, the revolution of the central spindle causes the cross bars to which the lazy tongs are pivoted to travel toward each other, and as the lazy tongs are thus gradually extended the ladder sections are hung in place, the apparatus being steadied by guy ropes when it reaches the elevated position. When the lazy tongs are again let down to folded position, the ladder sections are successively removed. To give the ladder an inclination transversely to the truck, the side screws are turned, thus tilting the upper frame. A single or double set of lazy tongs may be employed to support the ladder sections, and the weight is designed to be supported almost entirely by the guide rods, so that there shall be no undue strain on the central threaded spindle. The truck is preferably made with a crane neck. A modified form of this ladder may be used for domestic purposes, and by painters, decorators, etc.



McHENRY'S FIRE LADDER.

AN AUTOMATICALLY OPERATING VALVE GEAR.

This gear, which is of simple construction and not liable to get out of order, is designed to automatically increase or decrease the travel of the valve, to admit more or less steam to the cylinder according to the varying load. It is an improvement for which a patent has been recently granted Mr. Pascal J. Langlais, of Rhinelander, Wis. On the drive shaft of the engine is a cam wheel having in its periphery a groove in which travels a friction roller on one end of a lever fulcrumed on the frame of the engine, while the other end of the lever engages a slot in one arm of a bell-crank lever fulcrumed on a bracket. The other arm of the latter lever is segmental, and has a slot in which slides a block pivotally connected by a link with the stem of the slide valve. This block is also pivotally connected by a link with another bell crank lever, and the latter lever is pivotally connected by a link with a third bell crank lever connected by a rod with the stem of the governor. The latter connection is such as to permit the stem to turn without turning the rod, as the latter moves up and down with the governor stem, and the rod has a slot engaged by the inner end of a weighted lever fulcrumed on the governor frame. The arrangement is such that the position in the segmental slot of the block connected with the valve stem is controlled by the governor, the block being moved nearer to or away from the fulcrum point of the lever with increase or decrease of speed, whereby the travel of the valve will be regulated to decrease or increase the amount of steam admitted to the cylinder, the operation being automatically effected as the load on the engine varies.



LANGLAIS' VALVE GEAR.

Scientific Slaughtering.

Very few people have any idea what rigid economy is practiced at the great slaughtering plants. Scientific men are constantly cudgeling their brains to devise valuable chemical properties and new compounds in materials heretofore wasted or imperfectly utilized, says the *Drovers' Journal.*

The cross roads butcher who kills a few animals a week, throwing away a large part of the offal, must make a large profit on the meat sold, but modern utilization of by-products makes it so the slaughterer who does business on a large scale could much better afford to sell the meat without profit than to waste what the old-fashioned small butcher could not utilize.

The packing business as at present carried on utilizes a great number of products which were formerly allowed to go to waste. For instance, the stomachs of hogs, instead of being sent to the rendering tanks, are now used for the manufacture of pepsin. Pigs' feet, cattle feet, hide clippings and the pith of horns, as well as some of the bones, are used for the manufacture of glue. The paunches of the cattle are cleaned and made into tripe. The choicer parts of the fat from cattle are utilized for the manufacture of oleo oil, which is a constituent of butterine, and for stearine. Large quantities of the best of the leaf lard are also used for the manufacture of what is known as "neutral," also a constituent of butterine. The intestines are used for sausage casings; the bladders are used to pack putty in; the undigested food in the cattle stomachs is pressed and used for fuel; the long ends of the tails of cattle are sold to mattress makers, the horns and hoofs are carefully preserved and sold to the manufacturers of combs, buttons, etc. Many of the large white hoofs go to China, where they are made into jewelry. All of the blood is carefully preserved, coagulated by cooking with steam, then pressed and dried and sold to fertilizer manufacturers. All of the scrap from rendering operations is carefully preserved and dried and sold for fertilizers. Bones are dried and either ground into bone meal or used for the manufacture of bone charcoal, which is afterward utilized for refining sugar and in some other refining processes.

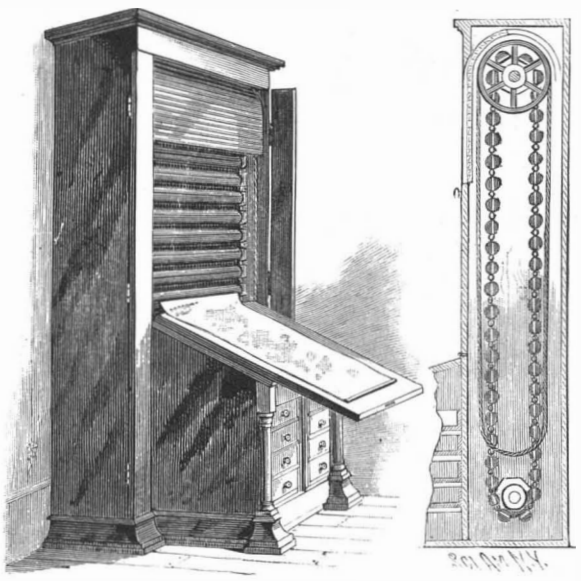
The Value of the Scientific American.

An old subscriber, who is a farmer in Michigan, in renewing his subscriptions to the SCIENTIFIC AMERICAN and SUPPLEMENT for the present year, writes as follows:

"This makes twenty-eight years' continuous subscription to the SCIENTIFIC AMERICAN. How is that for a mossback farmer? It has made electric engineers of both of my sons—one in the employ of O—— Company, New York City, and one of the G—— E—— Company, now at Helena, Mont. Both are graduates of Michigan University. I attribute a large share of their success to their reading the SCIENTIFIC AMERICAN."

AN IMPROVED EXHIBITING APPARATUS.

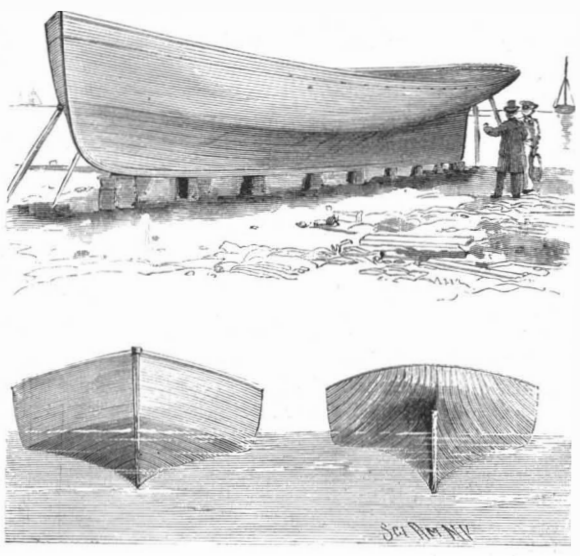
This apparatus may be made in a style which will include an elaborate combination of desk and case, or in a less expensive portable or wall style, in either instance making convenient the compact arrangement and ready display of maps, charts, drawings, fabrics, wall paper, carpets, shades, etc. It is designed for use in schools, railroad and express offices, retail stores, etc., or in a wide variety of ways, including use in the chart rooms of ships. The improvement has been patented by Mr. Daniel W. Tower, of Grand Rapids, Mich. The rolls of maps, fabrics, or other material are supported in holders on an endless carrier made up of links, as shown in the sectional view, each link having at one end a hook and at the opposite end an eye, and the chains thus formed running on sprocket wheels on top and bottom shafts in the case. At each end of the upper shaft is a hoisting pulley, over which passes a hand rope, by means of which the carrier may be moved to bring any desired roll in position for one end to be drawn out for inspection, such drawn out portion then lying on a downwardly swinging lid, with which the front of the case is provided. The case also has side doors and an upwardly swinging wooden curtain, such as is used in the ordinary roll top desk. The roll holders and rollers to receive the maps, fabrics, etc., extend completely around the endless carrier, being arranged between every pair of links. Each link has at one side a plate with a nearly cylindrical socket adapted to receive one end of the roll holder, the socket having at its front edge a slot, in which is inserted a squared stud on the end of the roller. A pivoted keeper on the front of the plate is provided for locking the stud in place, and the roller is actuated in the same manner as the ordinary shade roller, a spring brake, controlled by pressure of the finger, preventing the too easy or accidental rolling up of the map or fabric. The invention also provides for a modified form of carrier, designed to make the apparatus of still greater capacity.



TOWER'S EXHIBITING APPARATUS.

IMPROVEMENT IN VESSELS' HULLS.

The illustration represents an improvement in the hulls of vessels designed to afford the maximum of speed and safety, while the construction is such that drift to leeward will be in a great measure avoided. The invention has been patented in Canada and Great Britain, as well as in this country, by the Rev. Patrick O'Brien, of St. Patrick's Deanery, St. John's, Newfoundland. The bottom of the vessel is curved in convex form from the stem to the stern, and has a concave face from the keel to the sharp-edged bilge, while from the bilge to the top of the hull the sides are curved, presenting an outer convexed surface at the stern. The small figures represent bow and stern views. In every case where a cross section is taken through the bilge the sides and the bottom of the hull meet at an obtuse angle, and the outward inclination of the sides preferably increases from the ends of the hull. The steering qualities of vessels built after this plan are designed to be greatly improved, especially in high winds, which throw the hull over upon its side, as the bilge sections then serve as a side keel to hold the vessel to its course. This improved vessel has received the indorsement of many practical captains and seamen.



O'BRIEN'S VESSEL'S HULL.

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Erastria Scitula—an Important Predatory Insect.

An interesting paper upon the habits and metamorphoses of a predaceous lepidopter destructive to bark lice has just been published by Dr. H. Rouzaud, of Montpellier, France.

The adult insects of both sexes resemble each other closely, and both afford a striking example of protective resemblance, simulating in repose sparrow droppings. The moths issue at the close of the day, and upon emerging from the cocoon are extremely active. Whatever the position of the cocoon, whether upon the leaves, branches, trunk, or base of the tree, the moths drop immediately to the ground after emergence from the cocoon. They jump, roll over on the back, and vibrate the wing pads actively for forty seconds, and finally become perfectly motionless. Three or four minutes after birth their wings become expanded, and they fly up among the leaves and branches of the tree from which they have previously fallen. During daylight the moths remain motionless, the wings held close to the body, in which attitude, on account of their size, coloration, and general aspect, they bear the close resemblance just mentioned to the excrement of small birds. Copulation, which is of short duration, always takes place at night, the period during which the moths are active. The males live only one or two nights, in all probability, while the females in captivity live ten or twelve days at the least. Egg laying lasts several days, and each female produces about a hundred. These are deposited one at a time, and each is separated from the other by a large interval of space. The female scatters them by preference upon the leaves or the young buds, although they are often laid directly upon the back of the bark louse.

The young larva at once enters its host, devouring all the internal organs, leaving only the dorsal carapace, which is more or less thick and hard. A coccid which has been attacked always shows at some point or other on the dorsal surface an opening by which the predatory larva has entered. The young larvæ are of a red-wine color, except the head, which is brown, and this coloration lasts until just before the transformation to chrysalis. At the time of the transformation, however, a bluish white color is assumed. Although the size of the younger larvæ is not greater than that of the bark lice which they attack, they spin no silk at first and the spinnerets are rudimentary. As soon as the contents of one bark louse have been devoured the caterpillar abandons it and seeks a new prey, and is sometimes found exposed upon the twigs. Apparently realizing the necessity for protection, as well as additional food, it hastens to bury itself in a new victim, which usually is a matter of but some minutes. After having entered a bark louse it seems to be effectually protected from parasites.

M. Rouzaud has kindly offered to transport to this country for experimental purposes living specimens of this extremely valuable insect, and we have arranged to accept his kind offer to attempt the introduction of the species into California upon a somewhat extensive scale.

Although the black scale possesses in California, as well as in Hawaii, an efficacious parasite in *Dilophogaster californica*, the latter does not breed rapidly and seems to have but two annual generations. In Erastria we have a much more rapid breeder, and if it should accommodate itself to the somewhat changed climate, as we anticipate, its introduction will prove a boon to the California fruit grower.

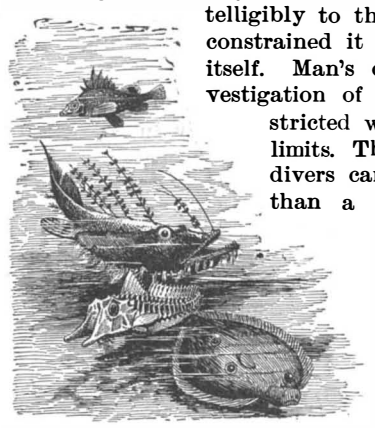
Other things being equal, the Erastria will prove a most profitable insect to introduce into California for work against the black scale. It comes from the native home of the scale insect and is there an effective enemy of the species.—*Abstract from Insect Life.*

Water Proof Masonry.

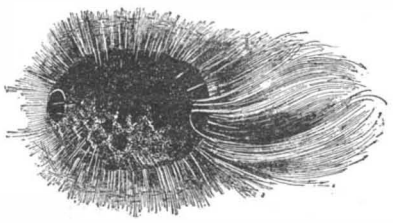
What was at first considered a doubtful experiment, viz., the use of coal tar as a means of rendering masonry impervious to water, especially in positions exposed to direct contact with the latter, has proved a practically valuable resort. Used as a coating for masonry built up of very porous stone, tar renders it quite impervious, even at a depth of some fifty feet of water, and, according to the opinion of those whose experience has been extensive with it, the article should be utilized in all public buildings, particularly those designed for the preservation of works of art, the dissolving action of water, even upon mortar of superior quality, being well known, and also the unfavorable effect of the exudation of water charged with lime salts from the mortar. Two methods of using the tar are named, viz., in a boiling state in one or several layers, this being suitable for surfaces exposed to the air; or it may be made to flame up before using, this being appropriate to surfaces which have to be covered up. It is stated that when boiling coal tar is employed in three coats on masonry the result is a black and very brilliant varnish, which perfectly resists the action of frost, water and sun, being likewise absolutely impervious; and the tendency of the black coating to absorb heat may be overcome by white-dusting the whole before the tar is quite dry.—*National Builder.*

IN OCEAN DEPTHS.

The greater part of the surface of the earth is hidden deep under the waves of the ocean. The area of the dry land is 136,000,000 square kilometers, while the water surface is approximately 374,000,000. This vast submarine area remained for long an unknown world. It is only in recent years that science has called intelligibly to the vasty deep, and constrained it to give account of itself. Man's direct personal investigation of the sea floor is restricted within very narrow limits. The most experienced divers cannot remain more than a few minutes at a depth of sixty fathoms. Investigation of the depths is now carried on by apparatus on shipboard. The ordinary deep sea lead is dispensed with, and a metal tube substituted. The tube is heavy and is further hung with weights which are increased with the depth of the floor. For great depths the weight is five or six hundred weights. The line, strengthened with steel wire, is several miles long, and is kept rolled on cylinders which are operated by steam power. The work is heavy, and to test the bottom at a depth of three or four miles occupies hours or even a whole day. Attached to the deep sea tube are other instruments for determining the temperature of the several strata of water passed through, and also for bringing to the surface samples of the water from various depths. But it is also desired to know whether the various depths of ocean are inhabited, and by what creatures. To this end specially designed nets are employed. A great deal of ingenuity has been spent on these nets, some of which open and shut automatically at prescribed depths. These arrangements admit, not only of exploring the sea floor and of bringing up samples of the ooze for investigation, but also of securing specimens of the types of life proper to various ocean depths.



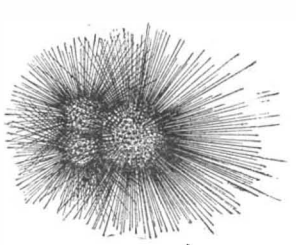
TYPES FROM INTERMEDIATE DEPTHS.



DEEP SEA SPONGE.

During the last thirty years, several countries have fitted out deep sea expeditions, and thousands of deep sea soundings have been made, but our knowledge is still very fragmentary. We have learned that the ocean floor is not a level surface, but furrowed like the surface of the dry land, and similarly diversified with hill and dale; but the mountains of the sea, instead of being subject to erosion like those on the dry land, are covered with a continuous soft shower of mineral and organic matter, interspersed with occasional bones and teeth. The ocean bed is almost invariably a loose material. In the neighborhood of the shore, the rock is covered with debris wrested from the land, or with sediment brought down by the rivers; but this extends only to a short distance from the land. The ocean depths are covered with a soft ooze. Everything that falls into the sea, and that has a greater specific gravity than its waters, sinks sooner or later to the bottom. Its floor is the sepulcher of all that lives and dies above—the treasure house of all that is committed to it. Meteoric stones innumerable have been quenched in it, and the floor is composed, in great part, of minute particles of iron—the so-called cosmic dust—and volcanic fragments and dust are widely distributed. Icebergs from the polar regions, freighted with rocks and other land debris, are often wafted into tropic waters before they melt and release their burdens. The sea receives everything, but, for the most part, the character of its floor is determined by its minutest denizens, the *diatomaceæ*, the *foraminiferæ*, and the *radiolarœ*. These short-lived creatures multiply and die, and their shells sink slowly, but surely, to the bottom, their innumerable multitudes falling in a perpetual soft shower. The floor of the Atlantic, from 1,000 meters to 4,000 meters deep, is, over large areas, covered with a characteristic material known as deep sea slime. Microscopic investigation shows that it is, for the most part, composed of microscopic shells of the *globigerina*, of which we present a magnified illustration. These are subjected to enormous pressure at great depth, and form chalk and limestone strata. Thousands of years may be required to form an inch of this deposit.

SEA LILY.
(*Metacrinus.*)



GLOBIGERINA.

On the surface of the deep sea, and again on its floor, life is abundant; but, at intermediate depths, the types are few and poorly represented. Fish which make their home in this desert of the sea are often exposed to hunger. Many of them are provided with a peculiar sac under the jaws—a bread bag—in which the fish stores the surplus when he has made a good catch.

It is remarkable that many deep sea fishes have very large eyes. It is, hence, evident that the depths are in some sort illuminated, even although the rays of the sun do not reach them. But many of the fish are themselves highly luminous—they carry their own lanterns about with them, in fact; and some, at least, of them can flash and extinguish their light at will.

The thousands of mariners who have gone down at sea will leave no durable remains, the minute dwellers of the deep leave nothing unconsumed, even the bones of whales dredged up are found bored through and through; but the depths of the Pacific have yielded countless thousands of sharks' teeth—thousands even at a haul—but the greater portion of them belong to extinct species.—*C. Falkenhorst, in the Literary Digest.*

Southern Inventors.

The *Boston Journal of Commerce*, alluding to important inventions made by Southern men, names a number who have contributed many notable inventions to science.

Despite the fact that the people of the South were but little engaged in scientific or mechanical pursuits, and that their intellectual energies have for the most part been absorbed with other thoughts, yet many notable inventions and contributions to science have been made by Southern men, writes Barton H. Wise, in the *Popular Science Monthly*. Cyrus H. McCormick, a native of Rockbridge County, Va., and the inventor of various agricultural implements, among them his famous reaper, received the thanks of the French Academy of Sciences for having done more for the cause of agriculture than any other man living. "Owing to McCormick's invention," said William H. Seward, in 1860, "the line of civilization moves westward thirty miles each year." Richard J. Gatling, of Hertford County, N. C., devised various machines and the Gatling gun, now an arm of the United States service and adopted by foreign governments as well. Both McCormick and Gatling moved west, the former to Chicago and the latter to St. Louis—the country districts of Virginia and North Carolina affording them poor fields for their endeavors. Henry J. Rogers, a Baltimorean, was the practical adviser and assistant of Morse in the construction of the first telegraph line in the United States, which was built in 1844, between Washington and Baltimore. He was the superintendent of it, and made many improvements in it, and was the inventor of several telegraphic instruments. Rogers also devised the first system of pyrotechnic signals in the United States and the one by means of flags that was adopted by the navy in 1846. The author of international fog signals was Samuel P. Griffin, of Georgia; and the inventor of the first complete system of ciphers used by the Associated Press was Dr. Alexander Jones, of North Carolina. The name of Maury stands above that of every other Southerner, if not of every American, in his contributions to science. Maury's writings demonstrated that meteorology could be raised to the certainty of a science, and Humboldt credited him with being its founder.

Sir Samuel Baker.

The distinguished African explorer Sir Samuel Baker died at his residence at Newton-Abbot, Devonshire, England, on December 30. He was born in London, June 8, 1821. In 1861 he formed a small party to proceed to the source of the Nile. Without guide or interpreter, he discovered, on March 23, 1865, the great fresh water lake which he christened Albert Nyanza. He proved that the Nile was navigable for large vessels as far as Gondokoro, 1,450 miles south of Khartoum. The slave trade of the interior, with Khartoum as its base, had grown to enormous proportions. In 1869 Sir Samuel Baker was appointed bey by the Viceroy of Egypt. In the face of great difficulties he worked his way through the hostile tribes, subduing them and abolishing the trade in slaves, until the name of the "White Pacha" was known and feared all through Central Africa. When his commission expired the slave trade was resumed with all its horrors.

As a writer, Sir Samuel was very entertaining, and his books had an enormous sale. Sir Samuel Baker takes a high place among the explorers of the dark continent, and his name will be ever remembered along with those of Livingstone, Grant, Speke, Sweinfurth, Stanley, and others.

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VENOMOUS SPIDERS.

BY NICOLAS PIKE.

In the acquisition of knowledge it cannot be too strongly impressed on the mind that the most common things met with in our daily walks we often know least about, yet they are deserving of our careful attention. Spiders, that we meet everywhere, and that constantly excite the horror of man, woman and child, so that their hands are ever raised against them, are, as a rule, perfectly harmless and often beneficial to man. I must confess that even I do not feel at ease with a large spider crawling over my person. Yet the study of their life history is most interesting. I have watched with delight the "orb weavers" constructing their geometrical webs; the skill with which the cocoon is fashioned and hung with the greatest care, and the adroitness displayed in drawing leaves together for either summer or winter home. It is all wonderful and shows a higher order of intelligence than is generally attributed to these curious creatures.

There has been a great deal written of and published in the newspapers, and also in "Insect Life," issued under the auspices of the government, in relation to venomous spiders, and especially to those of the genus *Latrodectus*. I have met with many of them in different parts of the world. I first procured some in Mauritius, also from Madagascar, La Digue, one of the Seychelles group of islands; from the foot of Table Mount, near Cape Town, South Africa; from Long Island, where it is common, and I have had it from the Southern States and Mexico. I thought Long Island was its northernmost limit, but Mr. Emerton, one of our best arachnologists, tells me he has met with it both in Connecticut and Massachusetts. Thus it will be seen the genus is widespread. As the bite of the *Latrodectus* is said to be very dangerous, I will give a description of and a *resumé* of facts connected with this and other spiders.

We have two species on Long Island—the *L. verecundum* and *L. lineatus*, but it is, I believe, only the bite of the former that is said to be poisonous. The female has a glossy black abdomen, with blood-red spots underneath, that often extend in a chain above, and a few white lines anteriorly, sometimes wanting. The male is noticeable from its slender form and long legs; the abdomen is black or dark brown, with orange or white spots, and the black coil of the palpus is visible. I have generally found it under the bark of old decayed stumps of trees, and in July under dead leaves in the woods. It spins a small web on low bushes, and remains in the center of it, feet uppermost, while the small egg-shaped cocoon is hung on one of the guys of the web. Though reputed to be so poisonous, I have handled quite a number, and brought some home alive to be sketched.

From all descriptions the Madagascar latrodectus has the worst character. It is called *Menavody* by the Malagaches, and from Dr. Vinson's account of it, after several moultings it appears to resemble our American *L. verecundum*. The female is much larger than the male, and does not scruple on the least provocation to devour her spouse. The young are also very pugnacious, and out of a large brood comparatively few arrive at maturity—a fortunate circumstance if it be true that this spider is so venomous.

The Rev. Paul Camboue,* a missionary of Tananarive in Madagascar, has recently published an account of the noxious and beneficial spiders of that island. He refers to the latrodectus as being reputed dangerous, giving even fatal bites, and from further information says he hears from "the east shore of the island that it is not the bite of the spider that is dangerous, but contact with the crushed body. This produces the inoculation of the venom, bringing about the gravest consequences with man and even the zebu."

When Dr. Vinson visited Madagascar he had quite a number of these spiders brought to him, but no case of poisoning came under his observation. He quotes another writer (Achille Percheron), who asks, "Have spiders venom?" and answers, "Yes; they possess it, but its action is relative to the animal attacked. A fly pierced by a spider perishes in a few moments; other insects more slowly according to size, but a man bitten by a spider in Paris would not be hurt any more than from the bite of a gnat. In warmer climates wounds are more serious, local inflammations ensue, and if neglected the heat of the climate brings more or less grave results and even death."

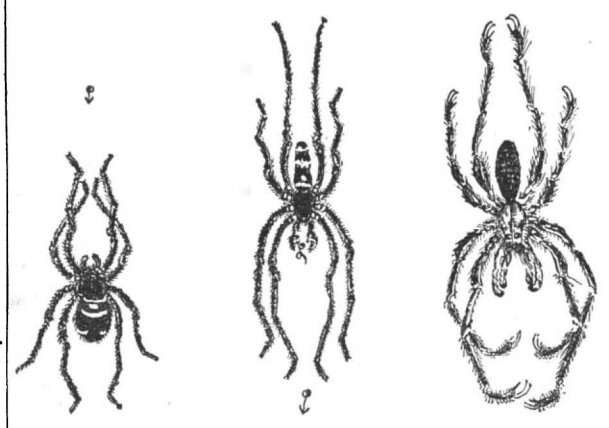
This is just my opinion. Of spiders possessing poisonous qualities and the will to inflict wounds there is not the least doubt. Examine a spider and you will find two falces on the head, each composed of a base and fang, the former simply a support to the cutting instrument. It has a groove on the under surface into which the fang folds down when not in use. The fangs are hard and sickle shaped, armed with numerous sharp teeth, and attached to each is a gland composed of a number of filaments united by a membrane into the form of a sac. The glands secrete a poisonous matter which is deadly to *insect* life. The fang is partly hollow, and through it the poison flows, and escapes from a small opening at the tip. When a spider seizes its prey it bites it with the fangs and partially paralyzes the victim. In all but the large spiders, some of which have strong, powerful fangs, the instruments are far too weak to penetrate the epidermis of a man's hand or foot.

In my studies of the arachnoids I have handled thousands of specimens and have several times been bitten by large ones here. On one occasion an *Epeira riparia* bit me on the cheek, but I did not experience more discomfort than from the bite of a mosquito. I believe the temperament of the individual counts greatly in all such cases. The man who carried my traps was bitten the same day by one of the same species on the ear as he passed through some bushes and broke down a large web, which the enraged spider resented. The bite swelled and produced pain and nausea, but a good dose of brandy soon relieved him, and I bathed the ear with some tincture of *Urtica urens* I always carried in case of an emergency, and he was soon all right.

Even mosquito bites, that only affect me temporarily, so seriously act upon some of my friends that painful swellings ensue and often last for days, probably caused by the impurity of blood, perhaps of a scrofulous nature.

Then a bite of a spider in our northern clime would doubtless have a very different effect to that in a hot country, like Madagascar. Just as our own rattlesnake, for instance, when taken from his winter hibernaculum, does not appear to have half the venom in its bite that it has in July and August, or that is possessed by Texas or Mexican rattlers in their tropical homes.

Numerous cases of spider bites have been reported to me, and some I have carefully investigated, and I must say that nearly all the reputed bites proved to be something else. In one instance, the patient com-



plained of numbness of the parts supposed to have been bitten, nausea, and chills of the whole body. The spider was shown me, and I identified it as *Attus tripunctatus*, a small one, that I saw at once was quite incapable of penetrating a man's hand, from the slight, weak fangs. In two days the hand and arm swelled so badly it was thought advisable to open the wound, when a piece of a needle was discovered that was embedded in the bone. A seamstress had carelessly left her needle sticking in a window sill. The man, seated near, threw his arm on the sill, when the needle broke in the palm of his hand; but the spider, passing over it at the same moment, was captured as the cause of the pain, and, until the opening of the wound, both patient and doctor persisted it had done the mischief, in spite of my protestation, and I could cite many other cases.

Though I have little belief in the poisonous bites of our small northern spiders, I am quite aware there are dangerous ones to come in contact with in hot climates. I will mention one that I think is very little, if at all, known outside of its own habitat. It is a native of Nicaragua, and is met with frequently in dwelling houses, among wearing apparel, and paper, in closets and wardrobes. Especially is it found among cotton and woolen goods, which it eats voraciously. It has been known to live a month on bits of paper, and is very troublesome among books. Truly, this spider appears to be omnivorous, and has cannibalistic tastes also, for it will devour another of the same species whenever opportunity offers. Place two individuals of the same size in a bottle, and in fifteen minutes the stronger will have eaten the other, leaving no vestige of him, and while feeding, the fore appendages work with a sawing movement, backward and forward. It is also found in the dry wood of old cacao trees and in the crevices of mud walls.

The name of this most undesirable tenant of a house in Spanish is *Casimpulga*, supposed to be the *Solpuga limbata*, Luc. It spins no web like a spider's, but deposits its eggs in the same way as she does. It is very pugnacious and will bite sharply if interfered with. The bite gives intense pain, traveling along the motor nerves to the heart, causing sharp, cutting pains in that organ and difficulty of respiration. The bitten member becomes swollen and assumes a dark color; high fever ensues, temperature 104°; black stools and convulsions continue for a month or more. In eight cases carefully investigated there were two deaths.

A young lady was bitten over the nerve of the middle finger of the right hand. The pain was intolerable and ascended up the arm to the heart, where it increased. The tongue was slightly paralyzed, breathing difficult and convulsions at intervals. The third day the temperature was 103° F., with vomitings and dejections black. The fifth day the fever subsided, but the pain lasted for forty days, with frequent convulsions, and the patient remained weak for some time after the pain subsided. I know the above is a fact, as I had it from the father of the young lady, a doctor himself. The solpugas are placed by entomologists among the *Pedipalpi*, below the true spiders, and all are noticeable for enlarged maxillæ, usually ending in a forceps, as this one has. The spider is light brown on the cephalothorax and dark on the abdomen, the legs and joints of various sizes and lengths. The curious appendages in front when examined under a microscope have the form of a crab's claw with strong teeth and forceps. Each of the hairy feet has two long claws and a sharp needle-like spine.

* See "Insect Life," vol. 2, No. 9, p. 273.

Fatal Spider Bites.

It has been generally believed in Jamaica, from quite early times, that serious results will arise from the bites of certain spiders. The following testimony from Dr. Cargill, of Half-Way Tree, confirms this belief, and has value as an independent statement of one who has had long experience in the island. The Queue-rouge is, of course, the *Latro ductus*, which is not uncommon in Jamaica. In the original MS. the omitted names are given, but I have received permission to send it for publication on condition that I omit them. The Colon spider is one of the old genus *Mygale*.—[T. D. A. Cockerell (June, 1893).

"It was supposed that the whitlow, which ended in blood poisoning, originated in a spider's bite (in Mrs. ———'s case), but I was never satisfied that such was really the case. People are very apt to mix up *post* and *propter hoc* occurrences. There can be no doubt that venomous spiders, such as the tarantula and black spider (the little red-tailed *Queue-rouge* especially), have occasioned death in rare instances, either by the direct lethal effects of their poison or by blood poisoning secondarily. I have never had any death from spider bite in my own practice, but I have had many cases attended with severe pain and serious inflammation of the joints of the fingers. Capt. ———'s first wife nearly lost a finger from a black spider bite, and the late Richard Hill (naturalist), an old friend of mine, told me that he had a friend who died from a spider bite on his tongue. The spider was a *Queue-rouge*, and had got between the blades of some guinea grass which he had put in his mouth. There is a very large spider in Colon, which the people call antelope, but which is no doubt a species of tarantula. This spider has been known to kill dogs and horses, and the bottle which contains a good specimen in our museum has a label which states that the spider was supposed to have killed a girl. We have many interesting spiders in Jamaica, and if I can get a red-tailed black spider, I will send it to you. It is far more venomous than a scorpion."—[Jasper Cargill (November, 1891).—*Insect Life*.

Action of Oxygen in Asphyxia.

With regard to the physiological action of oxygen in asphyxia, more especially in coal mines, a committee of the British Association has arrived at the following conclusions:

1. In the case of rabbits asphyxiated slowly or rapidly, oxygen is of no greater service than air, whether the recovery be brought about in an atmosphere contaminated by carbonic acid or completely free of carbonic acid, and whether artificial respiration be resorted to in addition or not.

2. Pure oxygen, when inhaled by a healthy man for five minutes, produces no appreciable effect on the respiratory rate and volume, nor on the pulse rate or volume.

3. Oxygen, whether pure or somewhat diluted, produced no effect on one particular patient, who suffered from cardiac dyspnœa of moderately severe type, in the direction of ameliorating the dyspnœa, and, compared with air inhaled under the same conditions, produced no appreciable effect, either on the respiratory rate and volume or on the pulse rate and volume.

4. An animal may be placed in a chamber, the general cavity of which contains about 50 per cent of carbonic acid, and retained there for a long time without supervention of muscular collapse, provided a gentle stream of a respirable air gas or oxygen, indifferently, be allowed to play upon the nostrils and agitate the surrounding atmosphere.

To Arrest a Cold.

Tincture gelsemium	gtt.	2
Liquid ergot	"	5
Camphor water	dr.	4

Mix, and take every hour immediately the cold is felt. If this is taken for twelve hours, at the same time keeping indoors in the warmth, many a cold will be cut short.—*Corr.-Bl. Schweiz. Aertze.*

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A NEW OPTICAL LANTERN.

(*Continued from first page.*)

York, the undesirable features have been entirely eliminated. The lamp is perfectly automatic in the control of the carbons, which are disposed at such an angle as to present the crater of the positive carbon to the condensing lenses of the projector. This feature is very desirable, for, when carbons are vertical, even if the negative carbon is advanced toward the condenser out of line of the positive, the light will proceed from the negative carbon as well as the positive, thus making two sources of light instead of one—a condition fatal to definition on high class work. If, however, the carbons are placed at an angle, as shown in the cut, the luminous spot on the negative carbon is obscured from the condenser, and the crater on the positive carbon is presented in a most favorable way. By an admirable system of mechanism in the lamp referred to, the point of the lower carbon is accurately maintained in a given position, and the upper carbon is gradually and regularly fed toward it in the exact proportion to its consumption. This mechanism is so simply and nicely adjusted that the lamp may be run for hours without a flicker, always maintaining the radiant in the optical center of the projector.

The regulating device is contained in a metal case only 2 inches thick by 3¼ inches wide and 4½ inches high, making it the most compact and easily adjusted lamp that has been brought to our notice.

The negative carbon is automatically moved upwardly as it burns away. The positive carbon is fed down by the weight of the carbon holder and by a small spring-actuated train of gearing, which is held in check while the arc is of normal length, or released when the length of the arc becomes too great, by a shunt magnet contained by the casing. The action of the shunt magnet is controlled by a spring acting on its armature; an increase in the tension of the spring increases the length of the arc, while a reduction of the tension diminishes the length of the arc.

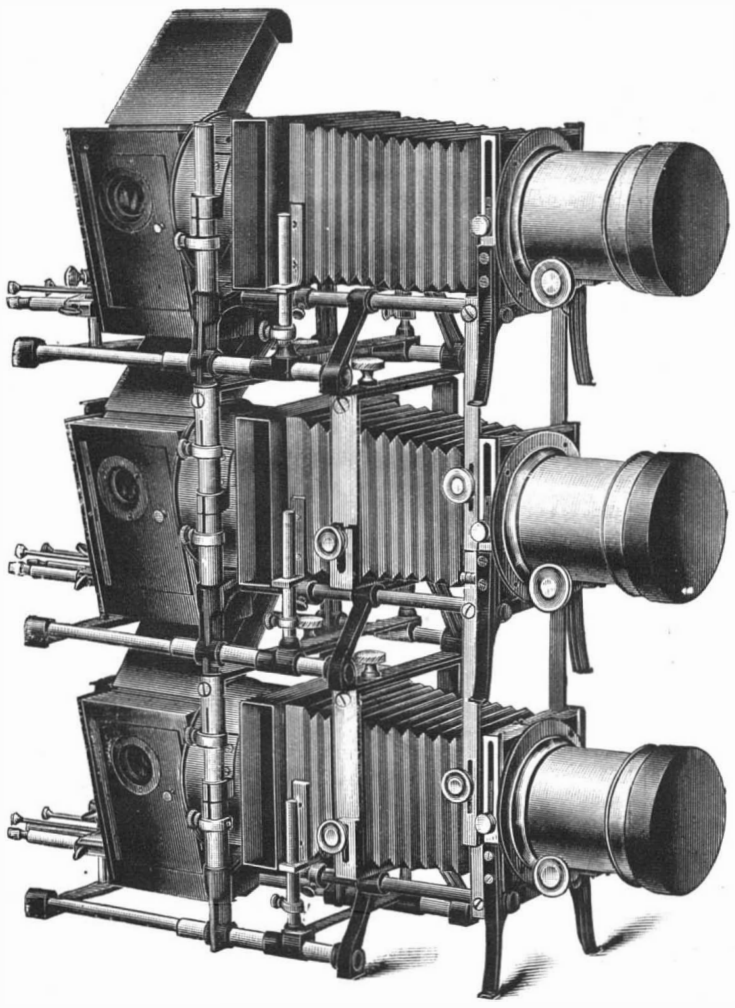
The mechanism controlling the carbons is so constructed that the lamp may be used on from five to twenty amperes of current, by the mere inserting of carbons of suitable sizes. The lamp is perfectly insulated, so it may be freely handled.

This lamp may be clamped on a vertical post, with a sliding base, admitting of universal adjustment; or it may be mounted otherwise, as may be desired. The utility of this lamp is by no means confined to optical projection, for, owing to its convenient size and the absolute steadiness of its light, it finds extensive use in photo-lithography and copying, micro-photography, for theatrical effects, and, in fact, all uses for which an intense artificial light is desired. The intensity of this light admits of the use of the optical projector in a room that is only partially darkened, which greatly increases its utility and widens its scope.

The same firm have recently taken out patents on a new form of optical lantern, which they have given the name of the "Criterion." This apparatus is constructed with a view to being universally adjustable and adaptable to optical projection in all its branches. It may be used singly, as shown in the large engraving, for the projection of ordinary views and diagrams, or two or three of them may be used side by side or mounted one above the other, as shown in Fig. 3, for producing the most elaborate dissolving effects, with either the oil, oxy-hydrogen, or electric light. The device for producing perfectly gradual dissolving effects with the electric light is original with this firm.

For scientific projections, the objective lenses, with their supports and slide box, may be entirely removed, giving place to the optical bench, as shown in the engraving of the improved polariscope. For the projection of experiments in acoustics, optics, microscopy, physics, chemistry or spectrum analysis, the various parts of the polariscope may be removed and other necessary appliances may be inserted in the sliding supports shown. The desirability of this interchangeable system may be seen at a glance. Among the apparatus that may be used on these sliding stands, in addition to that shown in the cut, are the crystal stage, supports for prisms, and physical appliances—mirrors, tuning forks, focusing lenses, adjustable slits, diaphragms, chemical tanks, and alum cells—a system of parallelizing lenses, microscope attachment, in fact, every conceivable form of apparatus for use in any position.

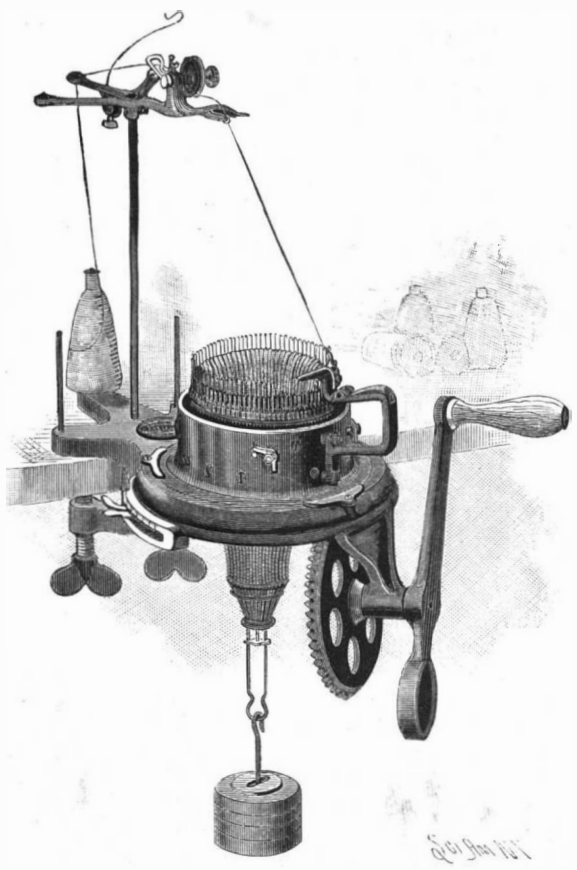
The condenser support is adjustable vertically, and various combinations of condensers may be inserted or removed from the front of this support. It would seem that no form of construction could admit of more universal adaptability. Again, the optical bench, as shown and described, may be removed, giving place to J. B. Colt & Co.'s improved forms of vertical projection and opaque attachments. A lantern like that represented in the large engraving is in use at the office of the SCIENTIFIC AMERICAN.



DISSOLVING VIEW LANTERN.

FAMILY KNITTING MACHINES.

The simply constructed and remarkably efficient hand knitting machine shown in the illustration was exhibited at the World's Columbian Exposition, and was awarded a premium. It is adapted for family and manufacturers' use, and in it are embodied the improvements resulting from twenty years successful experience in the manufacture and use of such machines, for it was in 1872 that James L. Branson, the president of the Branson Machine Company, obtained the first patent on the Branson machine. The hosiery made on this machine is seamless, and the stitch is the same as that made by hand knitting. The work is commenced at the top of the stocking, which is ribbed as far as required as if knit by hand, and the narrowing for shaping the leg is effected by a stitch regulator. The heel is made at the proper place by knitting backward and forward with the machine, being made double thickness if desired, but without a stitch being added by hand, after which the knitting of the foot is finished, except the joining of a few stitches at the toe, as indicated in one of the views, this being done by hand with a finishing needle. For the knitting of different sizes, and to enable one to use fine and coarse yarns, different sizes of interchangeable heads, as shown in one of the views, are made for the machine. With two sizes of the machine heads, and three needle cylinders containing different numbers and sizes and needles for coarse or fine yarns, all sizes and qualities of men's, women's and children's hose may be knit on the machine. The change from one head or needle cylinder to another is but a few minutes' work at any time. Among recent improvements in the machine is an attachment to hold down the work during the process of knitting, making possible the manufacture of finer and better goods and simplifying the operation of the machine, as it enables the same tension to be applied to the heel and toe as is applied to the circular portion of the hose. The operator retains hold of the crank during the whole operation of making the heel and toe, using the left hand to both raise and lower the needles. The heel is not held down nor is any weight attached to it, so that there is no strain on the yarn or pulling down on the heel by the operator. The machine is well built in all particulars. The office and manufactory of the Branson Machine Company is at No. 504 St. John Street, Philadelphia.



THE NEW BRANSON KNITTER.

HOSIERY MADE ON BRANSON KNITTER.

CHANGEABLE HEAD- BRANSON KNITTER.

Experimental Immunity from Influenza.

Our knowledge as regards the source and spread of influenza has been advanced but little, in spite of the recent occurrence of several epidemics. Dr. Brurchettini, however, still maintains that the bacillus which he has before described is the causal agent of this disease, and he again refers to his experiments on animals, especially those on rabbits, which proved to be particularly susceptible. The pathogenic value of this microbe has been strongly contested by Drs. Pfeiffer and Bech; but be its nature what it may, it is not without interest to know that Dr. Brurchettini has succeeded in producing in the rabbit an immunity against its attacks. The results of his experiments may be briefly summed up as follows:

Rabbits can be successfully inoculated without much difficulty, so that when subsequently treated with cultures of this bacillus (according to Dr. Brurchettini it is that of influenza) the animals remain perfectly unaffected. The material which gives the most complete immunity is obtained from cultures on blood serum filtered by Berkefield's method. The blood serum obtained from animals rendered immune possesses the property of rendering other animals likewise immune from infection by the bacillus and from its toxic effects; and so great does this power seem to be that it was found sufficient to employ serum only in the proportion of 1 to 42,000 relatively to the body weight, and even in doses less than this. Finally, this serum was found to be capable of exercising curative properties, for when injected into animals already inoculated with the bacillus and suffering from its effects in the most severe form the temperature fell to normal and the animals recovered, while control animals died in a few days.—*Lancet.*

DR. O. V. THAYER of San Francisco has successfully used the solar cautery—burning glass—in removing facial discolorations of the skin of large area, also in removing tattoo or India ink marks.

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IMPROVED AUTOMATIC SIGNAL APPARATUS.

In England at this season of the year all the railway companies are more or less troubled with fogs, and the question of the best methods of dealing with the immense traffic near the large centers of population requires very careful consideration. The *Engineer*, London, to which we are indebted for these illustrations and the following particulars, says: The system now generally employed is that of placing men at short distances apart alongside the various tracks, and the duty of these fogmen is to place detonators upon the rails. In order to increase the certainty of the signaling, it is usual to place two detonators at a distance of some ten yards apart, so that in case one should fail to explode it is practically certain that the other will give the required signal. In many cases detonators are left on the rails even after the fog has cleared off, and some of the men are not averse to the work, seeing that while employed on it they obtain about three times their usual pay. In both cases there is, of course, unnecessary expense.

On some lines pits are dug in the six-foot way, and the men are stationed in them and provided with open fires. This system, however, is a fruitful cause of rheumatism, brought on by the damp rising from the ground and the impossibility for movement on the part of the men. The work of fogmen is not entirely without danger from the explosion of the detonators, as there have been many cases where portions of the cases have injured the sight of the man employed. In order to obviate these difficulties, and to render the work of fog signaling more certain, while requiring the attention of fewer men, many inventors have brought out apparatus. Some of these mechanisms have been, however, too elaborate, and when subjected to the frequent shocks on the main lines have failed to work properly, while in other cases the apparatus has been too expensive.

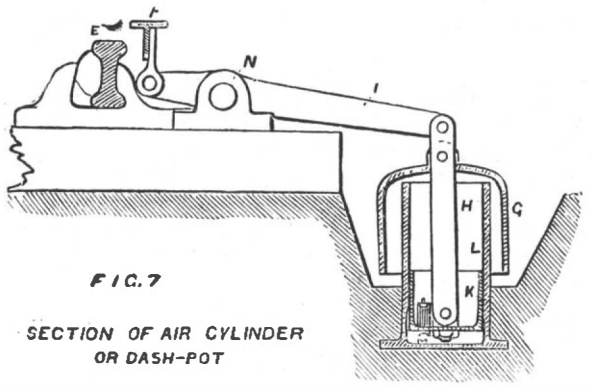
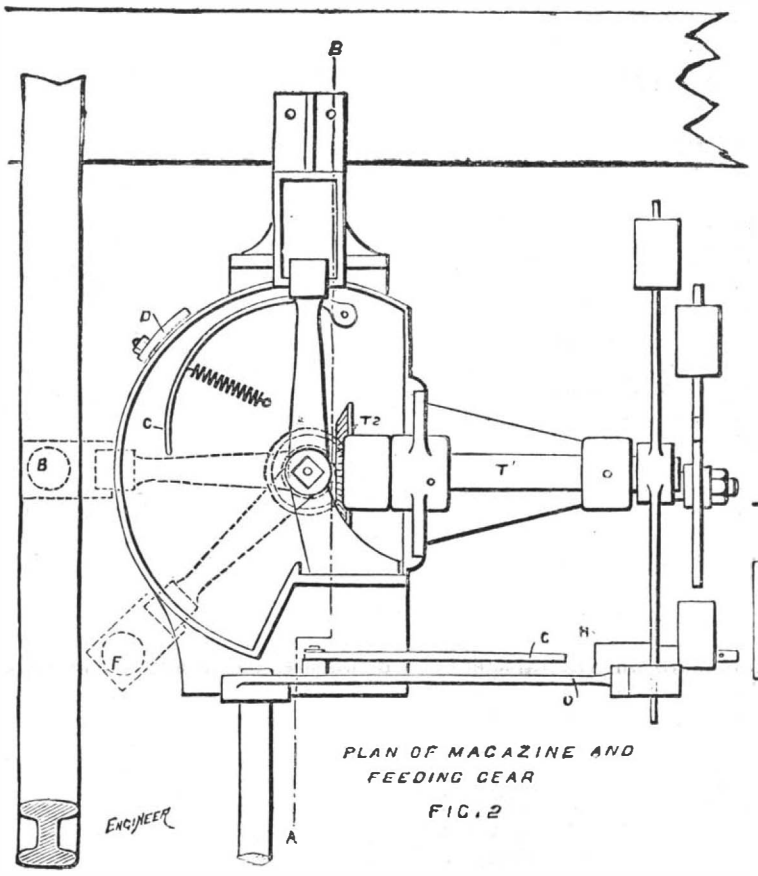


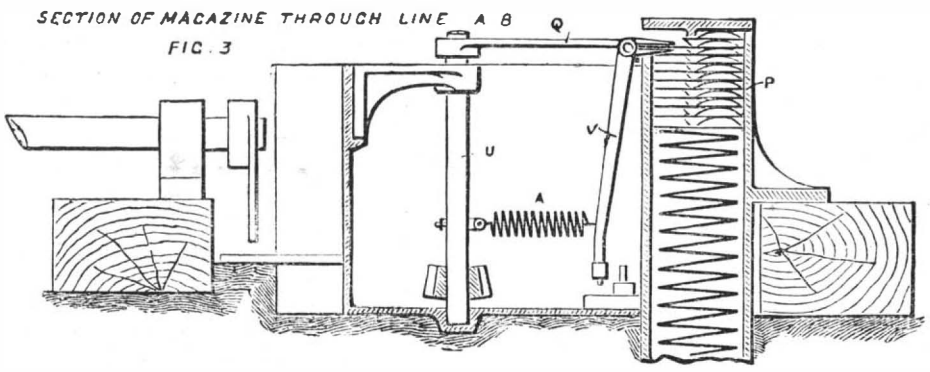
FIG. 7
SECTION OF AIR CYLINDER OR DASH-POT

We were recently invited to witness the working of a new apparatus invented by Mr. J. F. Dixon, of Huddersfield. On arriving at Holbeck, near Leeds, we found that a complete set of the apparatus had been fixed at a distance of about 200 yards from the station upon the main line, and the party was here joined by the inventor, who, along with Mr. Evans, explained the working of the apparatus. By the kindness of Mr. Ellis, of the Great Northern Railway, a locomotive had been provided, which was run backward and forward over the detonators to exhibit the action of the apparatus.

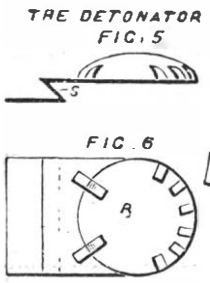
Fig. 1 is reproduced from a photograph, and shows the general arrangement of the mechanism outside the rail. It will be seen that the space occupied is not great, and that no obstruction is caused. Figs. 2 to 7 show the apparatus in detail. Referring to Fig. 7, E is the rail, and close alongside it is placed an inclined bar, F. This bar is pivoted at one end upon a sleeper,



PLAN OF MAGAZINE AND FEEDING GEAR
FIG. 2



SECTION OF MAGAZINE THROUGH LINE A B
FIG. 3



THE DETONATOR
FIG. 5

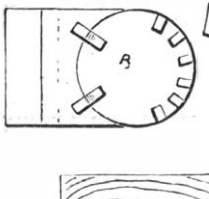


FIG. 6

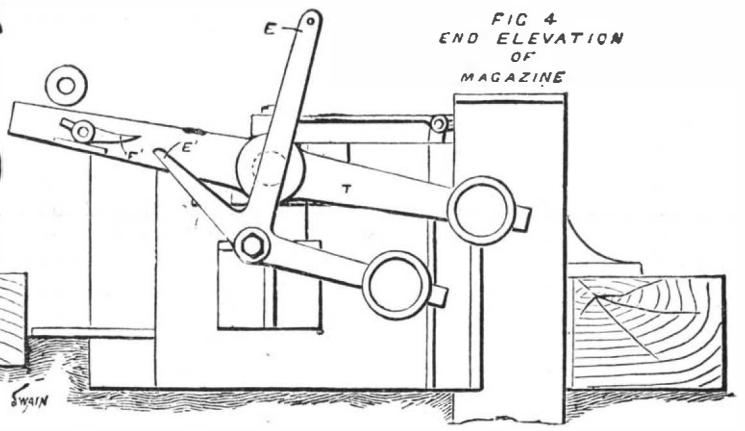
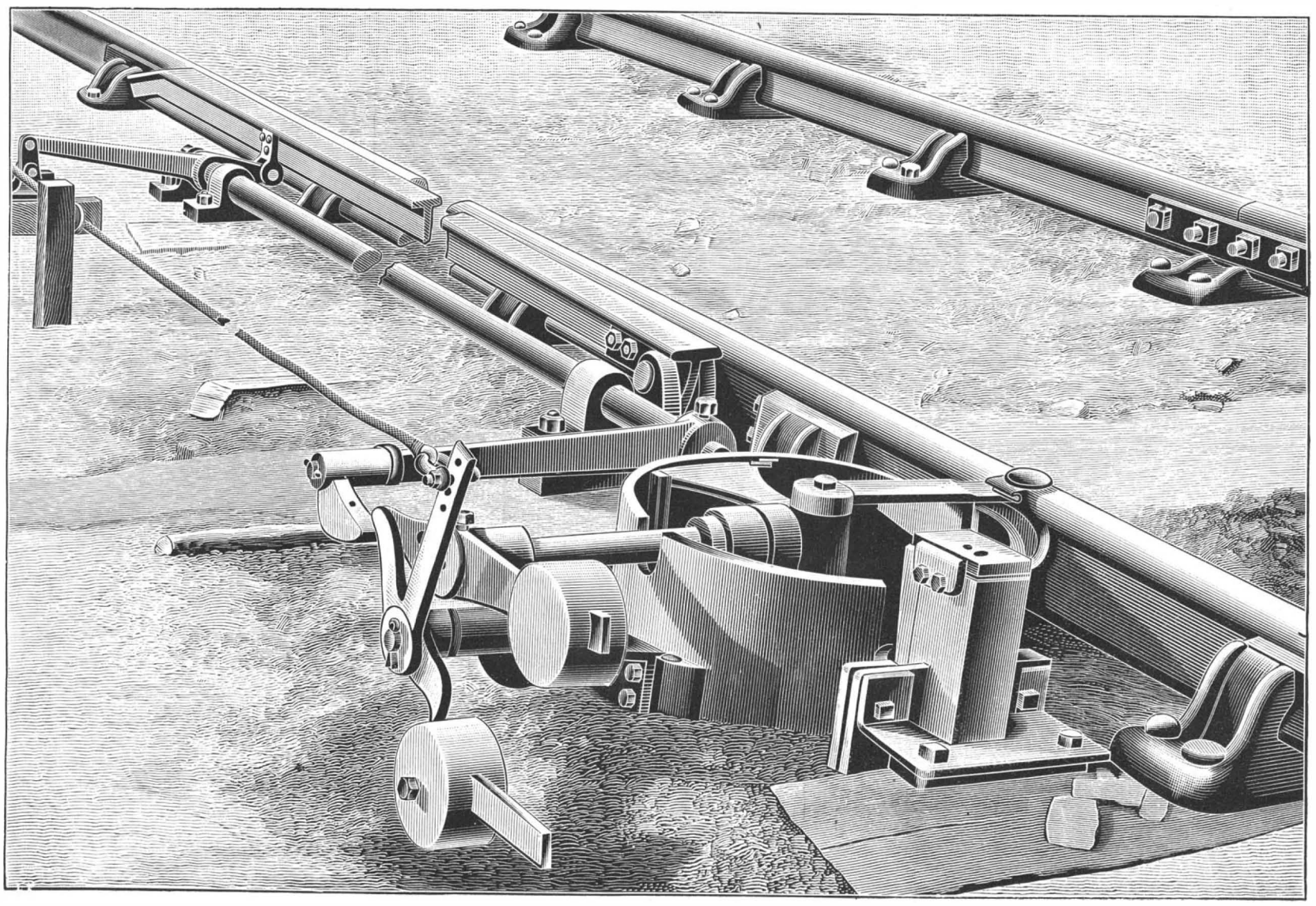


FIG 4
END ELEVATION OF MAGAZINE



IMPROVED AUTOMATIC SIGNAL APPARATUS.

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and the top of the tee-bar is at the same level as the top of the rail, while the other end is about 1½ in. higher than the top of the rail, and is therefore subject to depression as soon as a train passes over it. The depression of this bar actuates the whole apparatus. The arrangement really consists of two entirely separate parts—(*a*) the tee-bar and its controlling dashpot, (*b*) the detonator magazine and feeding apparatus. These two parts are not rigidly connected in any way, so that the jars to which the bar is necessarily subjected are not transmitted to the more delicate mechanism of the feeding apparatus. Fig. 7 is a section through the dashpot, and shows clearly its connection with the tee-bar. As soon as bar, F, is depressed, it lifts the link, H, by means of the lever, J, and causes the piston, K, to rise in the air vessel, L; this piston rises freely, owing to the opening of the valve, M. The cover, G, is attached to the lifting link, H, and is used merely to keep dirt out of the dashpot. At the same time the rocking shaft, N, is partially rotated and the lever, O, is raised. The train may now be supposed to have passed over the tee-bar; the lever, O, which is counterweighted, and the weight of the piston in the dashpot now cause the piston, K, to descend slowly in the cylinder, L. Two vertical grooves are cut inside the cylinder, L, which allow the piston to descend rapidly at the end of its stroke by permitting air to escape from underneath it. The valve, M, should of course allow no air to pass it. It is thus obvious that the speed at which a train may pass over the bar has no effect upon the action of this part of the apparatus, as it is entirely controlled by the dashpot. In fine weather the whole apparatus is put out of gear by wedging up the lever, O, on the dashpot side of the rocking shaft, and so permanently depressing the tee-bar to the level of the top of the rail.

We now pass to the magazine and feeding mechanism. Fig. 3 shows the magazine, P, most clearly. It consists of a cast iron box of rectangular cross section, provided with a light spring of the jack-in-the-box type, which continually presses upward the detonators piled upon it; the detonator is therefore always kept at the proper height to be seized by the forceps, Q. The detonators are formed as shown in Figs. 5 and 6, where R is the detonator proper, held by clips formed from the thin tinned plate, S. Supposing the tee-bar, F, to be pressed down by a passing train, or to be permanently held down as described by wedging the lever, O, then the counterweighted lever, T, Fig. 4, descends and partially revolves the spindle, T^1, Fig. 2, upon which is keyed a quadrant, T^2, gearing with a bevel wheel keyed upon the vertical shaft, U, Fig. 4. Upon the shaft, U, is keyed the forceps, Q, so that a descent of the tee-bar causes the forceps to rotate until opposite the magazine. The loose limb of the forceps is controlled by the spring, *a*, and the method of opening and closing the jaws of the forceps is very ingenious. Let us suppose that a detonator has been held upon the rail at B, Fig. 2, then a passing train would explode it, and, depressing the tee-bar, would allow the forceps to swing toward the magazine. In doing so the lower limb, V, which is provided with a small roller, would pass externally along the curved blade, *c*, and the jaws would be gradually opened until the catch, *d*, released the spent detonator, which then would fall to the ground; the jaws of the forceps, remaining wide open, would come opposite the detonator in the magazine, and at that instant the lever would reach the end of the curved blades, *c*, and would be smartly drawn back by the spring, A, so closing the jaws of the forceps upon the detonator. We may suppose that this series of movements has occupied two seconds; the forceps will remain opposite the magazine until the tee-bar again rises, which may take half a minute, or any shorter or longer interval desired, according to the fit of the plunger in the dashpot.

As soon as the tee-bar rises, the lever, O, falls, and the forceps moves round and places the new detonator on the rail. The curved blade, *c*, allows the limb, V, to press it out of the way, and then returns to its previous position. We have now described the action of the mechanism when detonators are required, and it must be clearly understood that in the normal condition a detonator is always on the rail, just as in the normal condition the signal is at danger. If the apparatus is placed out of use, the forceps remain opposite the magazine the whole time. As the signal given by the detonator must agree with that given by the signal arm, there must be a connection between the two, and this is effected by attaching the end, *e*, of the bell-crank lever, Fig. 4, to the lever which works the semaphore signal. If now the semaphore be pulled over to the "off" position, the bell crank lever descends, and its end, *e'*, catches the cam, *f'*, and causes the lever, T, to be partially rotated. This action is not very obvious in Fig. 4, as the lever, T, is supposed to be at its highest position, and the forceps to be just taking a new detonator out of the magazine; but in the normal position, with a detonator on the rail, the lever, T, is horizontal, and the end, *e'*, comes into gear with *f'*, owing to the fact of the center, upon which the bell crank lever turns, being out of plumb with the axis of the lever, T. By the descent of *f'* the quadrant and bevel wheels and vertical shaft, U, are actuated to the opposite direction to that previously described, and the detonator is swung off the rail from position, *b*, to position, *f*, where it remains so long as the signal is at "all right," and is, therefore, not exploded. The semaphore can thus be worked at any time, irrespective of whether a train is on the bar or not.

Another case which may be supposed is that of a train upon the bar, during which time the signalman might place the signal at danger before the train was clear. The return of the bell crank might cause another detonator to be placed upon the rail when it is not needed. This action has been foreseen, and a locking gear arranged. Referring to Fig. 2, a narrow bar, G, may be seen, which is actuated by the signal lever. This bar, G, comes over the piece, H, which is rigidly connected with the lever, T, and locks the apparatus so long as a train is on the bar. As soon as the train passes over, however, this lock is freed, and the apparatus is free to work. We may add that the magazine will hold fifty detonators, and it can be filled very easily. A small hole is provided in the cover, and by pressing down the spring by means of a short rod, the new detonators can be inserted one by one. The apparatus can be made so as to place two or three detonators upon the rail. That at Holbeck places two detonators on the rail at a distance of ten yards apart; this needs merely a duplication of the magazine and feeding mechanism. Only one dashpot and inclined bar are needed.

How to Make Plaster Casts of Objects of Natural History.

At a recent meeting of the Manchester Microscopical Society, Professor Boyd Dawkins, F.R.S., exhibited a number of casts in plaster of Paris of various objects of natural history, and explained the process by which any one can make them for himself. The material of the mould is artistic modeling wax, which is a composition akin to that which is used by dentists. And as it becomes soft and plastic by the application of heat, though in a cold state it is perfectly rigid, it may be applied to the most delicate object without injury. As it takes the most minute markings and striations of the original to which it is applied, the microscopic structure of the surface is faithfully reproduced in the cast. The method is briefly this:

1. Cover the object to be cast with a thin powder of steatite or French chalk, which prevents the adhesion of the wax.

2. After the wax has become soft, either from immersion in warm water or from exposure to the direct heat of the fire, apply it to the original, being careful to press it into the little cavities. Then carefully cut off the edges of the wax all round, if the under-cutting of the object necessitates the mould being in two or more pieces, and let the wax cool with the object in it, until it be sufficiently hard to bear the repetition of the operation on the uncovered portion of the object. The steatite prevents the one piece of the mould sticking to the other. The original ought to be taken out of the mould before the latter becomes perfectly cold and rigid, as in that case it is very difficult to extract.

3. Then pour in plaster of Paris, after having wetted the moulds to prevent bubbles of air lurking in the small interstices, and if the mould be in two pieces, it is generally convenient to fill them with plaster separately before putting them together.

4 Then dry the plaster casts either wholly or partially.

5. Paint the casts in water colors, which *must* be fainter than those of the original, because the next process adds to their intensity. The delicate shades of color in the original will be marked in the cast by the different quantities of the same color which are taken up by the different textures of the cast.

6. After drying the cast steep it in hard paraffin. The ordinary paraffin candles, which can be obtained from any grocer, will serve the purpose.

7. Cool, and polish the cast by hand with steatite.

The result of this process is far better than that obtained by any other. The whole operation is very simple, and promises to afford a means of comparison of natural history specimens in different countries which has long been felt to be a scientific need. Casts of type specimens may be multiplied to any extent at a small cost of time and money, and are as good as the original for purposes of comparison, and almost as hard as any fossil.

Professor Boyd Dawkins has employed it for copying flint implements, fossils, and bones and teeth which can scarcely be distinguished from the originals.

Notes on Wheat.

From field experiments carried on at the Agricultural Experiment Station, Purdue University, Indiana, reported in *Bulletin* 45, extending over ten years, it appears that none of the varieties of wheat tried have any tendency to deteriorate or "run out," provided proper care is exercised. No wheat proved to be "rust-proof," but early wheats were generally less injured by rust than later kinds. Eight pecks of seed per acre gave the best returns at the station, the average yield for nine years being 30·35 bushels per acre. The best results came from sowings made not later than September 20. The value of crop rotation in maintaining yields of grain has been strongly emphasized, for a comparison of rotating crops with constant grain cropping for seven years showed an average gain of 5·7 bushels per acre in favor of the former. Another important result obtained was that wheat may be harvested at any time from the dough stage to the dead-ripe condition, without appreciably affecting the weight or yield of the grain. A comparison of forms of nitrogen as fertilizers for wheat indicated that sulphate of ammonia is better than nitrate of soda or dried blood.

Oxygen for Enriching Gas.

At a late meeting of the Southern District Association of Gas Engineers and Managers, Dr. L. T. Thorne gave an account of further experiments with the new process for enriching coal gas by means of oxy-oil gas. Dr. Thorne has been enabled to carry out an exhaustive series of tests at Huddersfield, where the process is now in actual operation. His conclusions are summarized as follows:

1. The addition of oxygen to oil gas, preferably while the latter is still hot, not only increases the illuminating value of the oil gas when employed directly as illuminant, but also when it is used for purposes of enrichment.

2. Oxy-oil gas is a highly permanent gas, and when used as an enricher of coal gas actually increases the stability of that gas.

3. Enrichment of coal gas by oxy-oil gas would cost about one-third of a penny per candle per thousand cubic feet.

Dr. Thorne concludes by expressing the opinion that the experimental results place oxy-oil gas at the head of the enriching processes yet known, and fully justify the favorable view of the process which was expressed in an earlier communication. With regard to the actual working of the Huddersfield plant, we learn from *London*, the organ of the London County Council, of November 30, that the Huddersfield Corporation have now used the new gas continuously for over two months, and have obtained a steady white flame, affording a better light, while enabling a saving to be effected at the rate of £10,700 per annum. They are now using 36,000 cubic feet of the new gas per day for enriching the ordinary product. They have been in the habit of enriching their ordinary gas, which is of about 16 candle power, to the extent of four additional candles, by means of cannel coal. The cost per candle at Huddersfield, using Yorkshire cannel, has been about three-halfpence per cubic foot. With the new plant of the oxy-oil process the actual working cost is at present less than a halfpenny per candle per thousand cubic feet, and will eventually be still less by thirty per cent or more, as crude petroleum is rapidly becoming cheaper. Moreover, the coke produced from cannel coal is so useless that the Huddersfield Corporation have been unable to dispose of it, even to give it away. Under the new process they find no difficulty in selling all the coke they can produce for seven shillings and sixpence per ton. The saving due to enrichment amounts to £7,700 per annum, and the gain from sale of coke to £3,000, results which will have the practical effect of reducing the price of gas to the consumers at Huddersfield by at least threepence per thousand cubic feet, while supplying them with a more cheerful light, which is stable even in winter.—*Nature*.

Chemical Changes Effected by Mechanical Force.

In a recent article in the *American Journal of Science*, M. Carey Lea gives an interesting account of some of his experiments in which the salts of various substances were subjected to great pressure. For this purpose he used a powerful screw vise.

As it was intended to keep the substances which were to be subjected to pressure from any contact that might affect them, they were folded up in platinum foil, and this was set in a V-shaped piece of soft sheet copper. The portion of material which received the pressure was about one-half inch long by one-fourth wide; it consequently had an area of about one-eighth of a square inch. This limited surface received a pressure in the proportion of over a million pounds to the square inch, or about seventy thousand atmospheres. These, of course, are calculated pressures, subject to deduction for friction. The amount lost in this way cannot be determined, but is known to be considerable.

Certain salts of silver, iron, potassium, platinum, mercury, when subjected to pressure were visibly affected, the color being changed. The author says:

"We are justified in concluding that many of the salts of easily reducible metals, especially of silver, mercury, and platinum, undergo reduction by pressure. Such reactions are endothermic, and it therefore follows that mechanical force can bring about reactions which require expenditure of energy, which energy is supplied by mechanical force precisely in the same way that light, heat, and electricity supply energy in the endothermic changes which they bring about."

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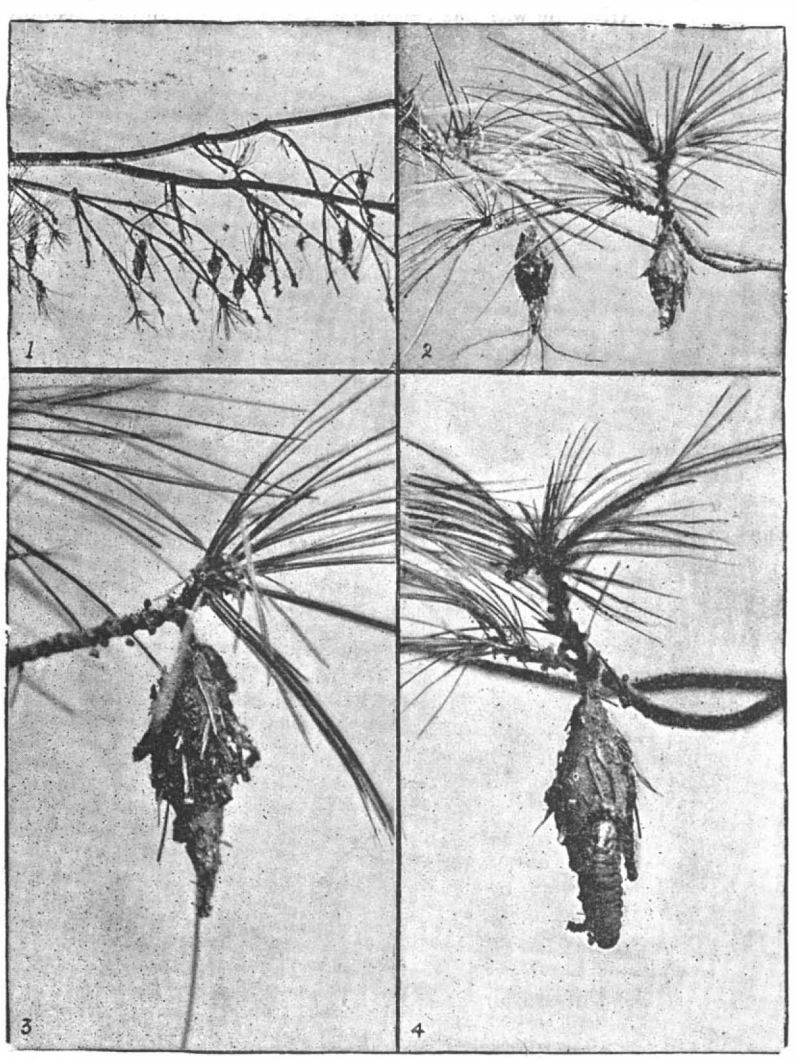
PINE CONES, OR COCOONS?

It is a well established fact that certain animals imitate the forms, colors and even the actions of other animals for the purpose of protection. Some animals carry this imitative instinct into the construction of their nests, burrows or cocoons. In no instance is this faculty carried to such an extent as in the cocoon of the pine tree moth. The *larva* of this moth spins its cocoon in the pine tree only, and builds it in exact imitation of the young pine cone or bud. This imitation is wonderfully like the genuine cone, and often deceives observers, unless they are exceptionally critical or are looking for the cocoons. I have carefully followed this moth through its metamorphoses from *larva* to *imago*. The female resembles the female of the common vaporer moth, and belongs to a kindred family, with habits, however, markedly different. I have reared only one female from the grub, a perfect and very beautiful specimen. She commenced oviposition the day after her extrusion from the cocoon, and was unfortunately crushed beneath a book which accidentally fell on her, before I had sketched or photographed her. This was the only *imago* of this moth that I have ever seen, although I have watched for it ever since my attention was called to it, two years ago. Judging from the care it takes to avoid notice, this *larva* must be a tidbit in the bills of fare of insectivorous animals. I had long been familiar with the grub, but had confounded it with the *larva* of a non-edible moth belonging to the *Liparidae*, which it closely resembles and probably imitates.

Its favorite food is couch or dog grass (*Triticum repens*) and kindred grasses, and it does not begin feeding until late in the evening, thus avoiding the attacks of birds. It hides during the day among the closely matted roots of the grass. About the last week in August it abandons its usual feeding grounds, and resorts to pine trees, where it feeds on the pine needles for two or three days. It then begins the construction of its cocoon. When this is about two-thirds completed, it protrudes its head and front pairs of legs and crawls about, dragging the cocoon with it, in search of small bits of twigs and pieces of bark. This it does at night, for this little creature rarely moves for any purpose during daylight. It never entirely leaves the cocoon, but extends its head and body as far as possible in its search for proper materials. The bits of twigs and bark are arranged in rows around the cocoon, and are always parallel with its axis. When this outside decoratio is finished it proceeds to a terminal twig and suspends its cocoon at the base of a bunch of needles, exactly where, in the course of nature, a cone would make its appearance. It then goes to feeding again, reaching out and drawing down the needles, at the base of which it hangs suspended. Every now and then it affixes a pine needle to the outside of the cocoon.

It feeds for four or five days, then closes the orifice of the cocoon and becomes a *pupa*. The time occupied in the construction of the cocoon, from the start to the finish, is about eight days. Before the *larva* suspends the cocoon to a terminal twig, and while it is engaged in applying the bits of bark, etc., to its outside, always during daylight, it seeks a bunch of needles and remains perfectly quiet until dusk. After the cocoon has been suspended, and if it is surprised by daylight while feeding, the grub withdraws into the cocoon and does not appear again until darkness falls. The bits of twigs and pine needles are not incorporated into the structure of the cocoon, but are applied outside on the surface; the twigs simulating the dark edged *laminae* of the young pine cone, and the fringe of needles, the needles growing from its base and apex. The needles have been stripped from one of the branches photographed, so that the cocoons and a belated cone might be clearly shown. It will take an acute eye to discriminate between the imitators and the imitated. At the distance of eight or ten feet it is almost impossible to distinguish the difference, and the uninitiated always insist that the cocoons are pine cones until they learn their mistake by a more thorough examination. I have removed a *larva* from a cocoon, and show it in one of the photographs. Metamorphosis has already commenced in the anal extremity of the grub. It has lost its posterior pairs of legs, and its body has become slightly flattened. The anterior portion remains unchanged; the *larva* was still feeding when it was removed, and was not yet ready to close the orifice and become a *pupa*. The *pupa* state is the most helpless of all the metamorphic stages through which this animal passes; consequently this creature needs protection more in this state than in any other; hence the mimicry of the young pine cone or bud which appears in the spring just at the time when the *pupa* is most helpless. Of course, when the cocoon is brought close to the eye, it loses its resemblance to the pine cone in all save shape. Seen among the thick pine needles and branches, it completely mimics the pendent cones, and deceives the most practiced eye.

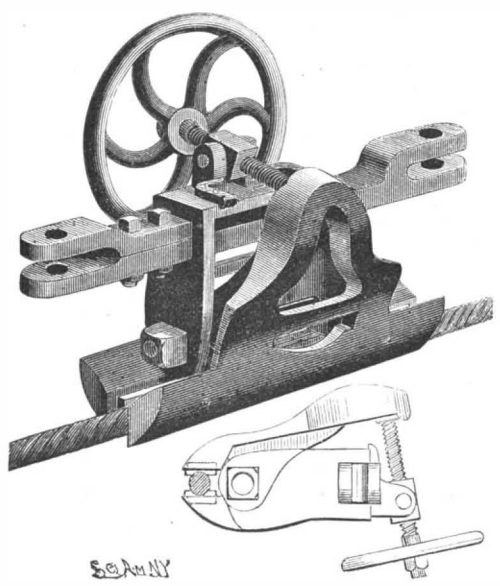
JAS. WEIR, JR.



1. COCOONS AND PINE CONE. 2. FINISHED COCOON AND ONE NEARLY SO. 3. OUTSIDE DECORATION. 4. LARVA AND COCOON.

A CABLE GRIP FOR COAL CARS OR MINE WAGONS.

This is an exceedingly strong, simple, easily operated device, which may be used as a coupling as well as a grip, the grip clasping the cable from the sides in such manner as not to bend or weaken it. The improvement has been patented by Mr. A. N. Humphreys, General Superintendent of the Westmoreland Coal Company, Irwin, Pa. In the small figure an end view of the device is shown, with the cable in cross section. The grip frame is widened at its lower end to form a jaw, and pivoted thereto is a swinging arm or plate having at its lower end the other jaw, each jaw being provided with a shoe held in place by rivets. On the top of the grip frame are bearing blocks in which is held a nut through which extends a screw shaft, one end of which is held in a socket in the upper end of the swinging grip arm, while the other end of the shaft has a hand wheel, by turning which the grip may be clamped upon or released from the cable. The grip frame is carried by a rectangular coupling bar having in each head a horizontal slot or mouth adapted to fit on the drawbar of one of the cars or wagons, the upper half of one of the heads being formed by a detachable plate. The grip thus becomes a coupler of two cars or wagons, and connects both cars or any number of coupled cars to a moving cable.



HUMPHREYS' CABLE GRIP.

Improved Brakes.

We learn from the *Railroad Gazette* that the Pennsylvania Railroad will shortly have all passenger cars equipped with the quick-action brake, and the locomotives equipped with the automatic engineer's valve. The process of changing from plain automatic to the quick-action brake has been going on for some time. The large number of cars and engines to be changed has necessarily delayed the matter until the present time. This shows the way in which brake matters are drifting, namely, toward the most powerful quick-acting and efficient brake that can be obtained for passenger service. Perhaps this turn in brake matters is emphasized by the investigation now being made into the efficiency of reinforced brakes. The reinforced brake has been brought out to do better work and more powerful braking than can be obtained from a quick-acting brake. It is found that in face of danger the length of stop, even with the quick-acting brake, is so great as to result in accidents, more particularly collisions. The reinforced brake is an improvement on the quick-acting brake; it does not make the brake act quicker; it makes it more powerful during the first part of the application, while the train is running at a high speed. The reinforcement comes during the early part of the application, and is reduced as the speed reduces, in order to prevent sliding the wheels. This reduction is also necessary in order that the maximum braking efficiency may be obtained, for the reason that if brakes were applied with the reinforced pressure at low speed the wheels would slide, and when the wheels do slide the retarding force is greatly decreased. There can be no doubt of the necessity of using quick-action brakes wherever possible and the reinforced brake for all high-speed trains; and it would appear, from present indications, that in the future it will be as necessary to use the reinforced quick-acting brake as an improvement on the plain quick-acting brake as it now is necessary to use the latter in the place of the plain automatic.

Do the Sick Ever Sneeze?

For somwhat over twelve months the readers of medical literature have been confronted in small caps with the conundrum: "Do the Sick Ever Sneeze?" We do not know why this inquiry has become so popular; no prize has been attached to its proper answer; in fact, comments and replies are not even solicited. But the simple query has been traveling around from Sheffield and London to Texas, Oregon, and Philadelphia, and it has not been answered yet. There are some problems which the human mind shrinks from grappling, sometimes because they are too deep and too consuming, or again because we dread the consequences of an awful certainty. No medical man has yet dared to come out squarely and say in so many words that the sick do or do not sneeze; and the world is curious to know whether this is due to fear or incompetency; or is it that doctors simply do not know? Perhaps despite the fact that this question—which was first thrown upon the world by Mr. Jonathan Hutchinson, the greatest living authority on a number of things—we say despite the fact that this question has been so continually pressed home to students of medical science, it may not yet have made the impression it ought. There is a deal of flippancy in the world, and some may have said on reading the inquiry, supposing the sick do sneeze, or do not, what the dickens is the odds? Well, we shall still have cakes and ale irrespective of sternutation, but science exists for the purpose of adding to the eternal verities; hence the question of sneezing must be dealt with seriously and answered in accordance with the illumination furnished by thorough and matured knowledge. It cannot be lightly thrust away by appealing to points of economics.

We are aware that collective investigation is a little out of fashion, but here is an opportunity for fruitful work, and we should like to have our readers lay aside mental indolence and address themselves boldly to Mr. Hutchinson's problem in hyperkinetics: "Do the Sick Ever Sneeze?" The eminent author himself has never seen a sick man sneeze; on the other hand, we venture to say that we have never seen a man sneeze who thought he was perfectly well. Between these wide ranges of experience there lie rich fields, fructifying study.—*Medical Record.*

ONE thousand rose trees are ordinarily required to supply two ounces of attar of roses.

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RECENTLY PATENTED INVENTIONS.

Engineering.

CUT-OFF GOVERNOR.—George M. Hull, Kearney, Neb. This is a device more especially adapted for use in connection with rotary or other high speed engines. Upon a rotary shaft is a fixed cam, and a rotary cam held for limited reverse or lag motion as the shaft rotates, to close over the cam recesses in the fixed cam. a valve-operating crank arm engaging both of the cams. The arrangement is such that the movement of the cut-off valve in the steam chest varies in exact proportion to the speed of the rotation of the shaft, forming a variable cut-off governor of very simple construction, but which is effective and positive in its operation.

Railway Appliances.

CAR COUPLING.—Valentine Erbach, Scranton, Pa. According to this improvement the coupling hook, pivoted in the drawhead, has a shank and twin heads, arranged one at the rear of the other, the inner face of the outer head being concaved and the corresponding face of the inner head convexed. The construction is such that when coupled with the link or hook of an opposing drawhead, no matter how decided the curve, the hooks or links of the couplers will have two bearings, and ample play will be provided for the drawheads and links, both vertically and laterally. The coupling is inexpensive and the hooks are so strong that there is but little danger of their becoming injured.

A further patent by the same inventor provides a drawbar attachment between the drawhead and the body of the car admitting of the drawhead being carried laterally to any desired angle. The attachment may be readily applied to a drawhead of any description, and the invention further comprises the employment of a spring to compensate for any sudden jerks incident to the sudden stopping and starting of cars, the construction being very simple, durable, and inexpensive.

CAR COUPLING.—Charles B. and Thales D. Stewart, Walla Walla, Washington. These inventors have devised an improvement in couplers of the link and vertical pin type, adapted to effect the automatic coupling of cars by their impact as the drawheads come together, the uncoupling being effected from either the side or the roof of the car. In a chambered drawhead is a guide box adapted to be opened at the front, a spring-pressed perforated diaphragm plate sliding longitudinally between the guide box and drawhead, while a coupling pin working in the guide box is adapted to pass through the holes in the diaphragm plate and drawhead when the perforations are aligned.

CAR DOOR.—Ferdinand E. Canda, New York City. This is a door more especially designed for refrigerator cars, to effectually render the car air tight or permit ventilation whenever desired. The door frame is secured to the inner surface of the car side, and a door closes the opening in the frame, while an inner auxiliary door is fitted to slide on the inner surface of the door frame. The door is absolutely air tight, is adjustable to any ordinary irregularity, and is not affected by any sagging of the car body.

Mechanical.

KNITTING MACHINE.—Carl B. Sander, Chemnitz, Germany. This machine has a revoluble pattern thread and band carrier journaled in a sliding bearing, with means for imparting intermittent rotary motions, and in opposite directions, to the carrier. The machine is of simple and durable construction, and is arrranged to wind a band, braid, cord, etc., around some of the pattern threads.

SEWING MACHINE PRESSER FOOT MECHANISM.—Henry A. Dodge, Boston, Mass., Walter G. Tillou, New Haven, Conn., and William T. Richards, Newton, Mass. This improvement relates especially to leather sewing machines, and comprises such construction of the presser foot and its connection with the presser bar that the foot will be capable of three adjustments—a vertical, a horizontal upon a plane, and a rotary in a horizontal direction, the latter being a fine adjustment. The arrangement is such that the presser foot and the setting points of its under surface can be quickly adjusted to the center line of stitching, the adjustment being further advantageously brought into action should the stitching be irregular, and with irregularities in the surface of the material.

MECHANICAL MOVEMENT.—Isaac S. Bryant, La Junta, Col. This inventor provides a movement of simple and durable construction, more especially designed for use on engines and other motors, to convert reciprocating into rotary motion, avoiding all dead center positions of the transmitting parts. It consists of a reciprocating crosshead on which are mounted sprocket wheels engaging the upper and lower strands of a sprocket chain, the wheels being adapted to be locked in position by pawl and ratchet mechanisms.

NAIL SET.—Charles F. Markley, Hopkins, Mo. This is a simple and cheap device, which can be carried in the hand or the nail pocket, there being in its body portion a central aperture through which a finger may be passed to hold the set out of the way when not in use, while at either end are extensions forming punches or set members proper. The set members are of different sizes and adapted to operate on large or small finished nails or brads.

STAPLE FORCEPS.—Stephen L. Griffith, Chardon, Ohio. This is a device in which opposing jaws are independently pivoted on a handle to which is also fulcrumed a lever adapted to engage each of the jaws in the rear of its pivot. The device is very strong and simple, and enables the user to quickly and conveniently remove staples from posts or other places.

NUT WRENCH.—Fred A. Carrithers, Pekin, Ill. In this tool a fixed jaw and handle are connected to a shank, and a ratchet bar is held against displacement in relation to the handle, while a movable jaw slides on the shank and on the ratchet bar, a screw mechanism moving the handle with the ratchet bar longitudinally of the shank. The tool is especially adapted for a pipe wrench, having means to clamp an elbow efficiently, and it may also be used as an ordinary monkey wrench.

SELF LOCKING NUT.—Walter E. Bunker, Natick, Mass. This nut has an integral cup-like base, united at its crown directly to the nut proper, such cup-like portion having in its outer bearing edge upwardly extending slits, whereby the crown of the cup will operate as a brace and support for each of the spring sections formed by slitting the edge of the cup. A considerable frictional contact is thus obtained when the nut is applied, to prevent any accidental reverse movement of the nut.

Electrical.

CARTRIDGE SHELL BATTERY.—James J. Pearson, Brooklyn, N. Y. This is a compact, powerful and inexpensive sealed battery, whose outer casing consists of an ordinary cartridge shell, with a cylindrical lining of zinc or other electro-positive material, a cylinder of silver chloride forming the negative element supported by elastic insulating disks. An electrolytic body is interposed between the chloride of silver cylinder and the zinc lining, a hermetic seal closing the open end of the shell, and a silver wire extends through the seal and passes in a zigzag direction through the silver chloride cylinder, the open end of the shell being contracted or grooved to retain the contents.

WARPING MACHINE STOP MOTION.—Clayton Denn, John Cocker, and Charles Denn, Philadelphia, Pa. This is an improvement in stop motions where an electric circuit is closed by the breaking of a yarn or thread, the current then operating mechanism to stop the machine and prevent the manufacture of imperfect goods. The improvement relates more particularly to the sliding guides supported by the yarns, and which operate as circuit closers, the slides being so arranged that when dropped by the yarns they will make a sliding contact with adjacent terminals, there being always sufficient surface engaged to insure the closing of the circuit, while the parts are not liable to oxidize to such an extent as to interfere with the closing.

LETTER ELEVATOR.—Bernard Waldstein, New York City. This invention relates to means for elevating letters, parcels, etc., from the ground floor of an office building or dwelling to the upper compartments, the elevating device being set in operation from the upper floors to automatically elevate or lower the parcel carriage. An electric motor, operated in the usual manner, is employed to elevate and lower the carriage, and one of the circuit wires is run adjacent to the upper or discharge end of the chute, the connection being such that by moving a switch the occupant of a particular compartment may raise and lower the carrier.

Agricultural.

CORN HARVESTER.—George H. Schauck, Libertyville, Ill. This machine has a vertically adjustable caster wheel support at its front end, and the rear axle has crank portions, and hinged to the rear end of the main or cutter frame is a tilting shock-forming platform having ways for supporting the lower ends of the stalks as they are slid off. The machine cuts standing corn and delivers it onto the platform, binds it into a shock, and slides it off to the ground. The main frame and platform can be raised and lowered to cut the stalk at the point desired, and the machine is of simple and inexpensive construction and easily run.

MOWING MACHINE.—Benjamin J. Sykes, Sykesville, Pa. This invention relates particularly to endless knife machines, and provides improvements therein whereby the cutting apparatus will normally be held down upon the ground, but allowed to rise when an obstruction is encountered, and immediately thrown down again when the obstruction has been passed. The construction is such as to relieve all parts of undue strain, the endless knife is safely guided and protected from grass at all times, and the driving gear attached to inner end of finger bar is also protected. The finger bar is operated by a foot lever, leaving both hands free for the management of the team.

MILK CAN.—Charles E. Hinman, Oxford, Neb. This is an improvement upon a formerly patented can in which a tapering plug is forced into the can to compress the milk globules and prevent agitation of the milk when the can is shipped. The plug, according to this improvement, extends downward through the can, and is a hollow central plug of such capacity that ice may be packed in it to keep the milk cool, means being provided for catching the overflow when the plug is inserted, and for firmly fastening the plug, sealing the can, and bracing it so that its bottom will not bulge.

DRAUGHT EQUALIZER.—Samuel I. Larkins, Murray, Ia. A span bar at one side of the tongue, according to this invention, carries a double tree, and an equalizing bar attached over the span bar extends across the tongue, with a double tree attached to its free end, the single trees of which are on opposite sides of the tongue. The evener at one side of the tongue is pivotally connected with the vehicle or machine to be drawn, the device being especially designed for use with reapers and harvesters. It will perfectly equalize the draught of a four-horse team, three of the horses being on one side of the pole, and thus carry forward, with even draught, any character of load.

Miscellaneous.

BRICK KILN.—Carriel Forrester and Augustus H. Donecken, Omaha, Neb. This is a continuously operating kiln in which interchangeable parts are employed in connection with a central permanent part, and arranged in such a manner that, as one section of the kiln has been burned and cooled, and the bricks are removed, such parts can be moved forward to form a new or green section while the intermediate sections are firing. Permanent and detachable flues are so arranged and provided with dampers that the draught can be regulated right and left through the bricks at will, giving an even distribution of heat all over.

FREIGHT TRANSFERRING DEVICE.—Oliver Spitzer, Brooklyn, N. Y. A cable running in an underground track has a projection adapted to engage and move a wheeled truck, the latter moving a hand truck or other vehicle carrying the load. Provision is made for guiding the cable around curves, etc., and the construction is simple and durable, being especially designed for use on docks, and in warehouses, factories, etc., for conveniently and quickly transferring goods.

GUN BARREL PISTOL ATTACHMENT.—Mandal W. Fairbanks, Boonville, Cal. This is a device for holding a pistol parallel with the barrel of the gun, and is so made that the gun constitutes a rest or support for the pistol, the latter being sighted and fired when the stock of the gun is brought to the shoulder in as accurate a manner as though the sight were taken over the barrel of the gun, or one can use the sights on the gun barrel for a long range. The improvement is designed to present decided advantages over a double or three barreled gun, as the weight of the gun is not materially increased, and the attachment can easily be removed and replaced as desired.

FOOT FOR DREDGES.—Edward Woods, Sault Ste. Marie, Mich. This foot comprises a post on which are pivoted wings adapted to open and close, while blocks sliding on the post engage the inner edges of the wings to fill the gap when they are in closed or folded position. With this foot a dredge will be securely held in place, and the post with the foot, usually embedded deep in the mud, will readily come up as soon as the dredge swings and raises her anchor.

HOSE COUPLING.—Joseph S. Blackburn, Salem, Ohio. One section of this coupling has a shoulder and the abutting section has projecting pivoted spring-controlled jaws adapted for engagement with the shoulder, there being levers connected with the jaws for raising them out of contact with the shoulder. The arrangement is such that the coupling is automatically effected when two sections of hose are brought together and forced to a contact, and means are also provided whereby there can be no possible leak at the point of junction. The uncoupling is quickly and easily effected by the levers.

HAIR CLIPPER.—Silas N. Chaney, Grangeville, La. In this device the hair clipped is carried away by an air current, which also serves to carry off any loose dandruff in the hair, the cutting being smoothly and evenly effected, and the whole work neatly done. It comprises a hollow body at one end of which is a slotted plate, a revoluble knife driven by a propeller or wind wheel turning on the inner face of the slotted plate, while a hose leading from one end of the body is connected with an exhaust fan.

WRAPPER HOLDER.—Robert E. Glasgow, Richmond, Va. This invention relates to machines for making cigars and cigarettes by hand, and provides a holder designed to greatly facilitate the wrapping of the filler by hand in making high grade goods. A movable clamping plate is arranged to clamp the edge of the wrapper on a movable rolling plate operatively connected with it, and in such way as to permit the operator to straighten out the wrapper and roll in the filler, the two plates forming a rolling surface for completely rolling in the filler.

SAFE.—Eben N. Gower, Jr., Flowery Branch, Ga. At one end of this safe is a transverse partition extending from the front to the rear wall, and forming a closed compartment, a safe bolt work being mounted on the door, and a dial shaft extending through the front wall to the rear of the closed compartment, while a bolt-operating mechanism within the main compartment of the safe is connected with the rear end of the dial shaft through the rear end of the partition. Tampering with the combination lock is impossible, as the lock is inside of the safe, and only the dial is on the outside, and the removal of the latter does not affect the lock and bolt mechanism.

BOTTLE STOPPER.—Floyd T. Smith, New York City. This device comprises a casing having inwardly extending annular flanges in connection with a valve formed of two semi-spherical sections, with their convex surfaces in contact and secured to a valve stem sliding in supports in openings surrounded by the flanges. When this stopper is in the neck of a bottle, the refilling of the bottle is impossible, although the contents of the bottle may be readily poured out, and the removal of the stopper from the bottle may be readily detected.

WAGON SEAT.—Charles C. Field, New York City. According to this improvement a re-enforcing arm extends up over the front edge of the seat onto the top surface of the seat bottom. The invention is an improvement on a former patented invention of the same inventor, insuring the seat being securely held in place on its supporting bar, without danger of breaking or weakening the pivot bolt and other parts.

HOLDBACK FOR VEHICLES.—Evangeliste Marleau, Houghton, Mich. A toothed and slotted block is, according to this improvement, fastened on the shaft, and a toothed locking plate is attached to the holdback strap, a locking device being also carried by the locking section. The device is simple, durable and inexpensive, and the two sections may quickly and easily be brought into locking engagement or unlocked, even when one is wearing mits or gloves.

FENCE.—John W. Moore, Oakland, O. This invention provides a wire fence that may be readily removed from one place and erected in another. Novel connections are provided for the fence wires, new means for stretching the wires separately, a new device for anchor bracing the fence at the ends, superior means to compensate for the expansion and contraction of the wires and an improved method for the support of iron fence posts where such posts are used.

SODA WATER FOUNTAIN.—William H. Ricker, Cambridge, Mass. This improvement provides a casing in which is a revolving partition having a central ice receptacle, around which is a series of apertures designed to hold a number of jars with automatically closing stoppers. Any one of the jars may be readily brought to a certain point to discharge a portion of its contents as desired. The device is very simple and inexpensive.

AWNING ELEVATOR.—Frank R. Ashley, Denver, Col. This is a raising and lowering device, comprising two weights traveling in a pocket, and one of the weights having a chamber to receive the other weight, while a cable attached to the smaller weight passes through the larger one and is connected with the awning, a hoist rope leading to a fastening device being likewise connected with the smaller weight. The mechanism is concealed from view and protected from the weather, and the awning may be adjusted as desired from the inside of a room.

BOX OR DRAWER.—Joseph S. Bennett, Winnipeg, Canada. The sides and bottom of this box or drawer are formed of a single piece of metal, the sides being bent up and having inwardly bent right-angled flanges, which lie in kerfs in the sides of the box ends, the bottom ends also having similar flanges lying in kerfs in the bottoms of the box ends, the latter being preferably of wood. In this way is made a light, strong box, free from rough edges or nail heads and well adapted for storing hardware or other heavy goods.

PAPER BOX.—George A. Colgan, Brooklyn, N. Y. This box has one elongated flap, which effects a closure of both ends of the box and is capable of longitudinal movement to project the contents of the box, such as cigarettes, slightly beyond the end, to facilitate their withdrawal as desired. Such boxes take a minimum of material, time and labor in their manufacture, are of sufficient strength for many purposes and may be packed in small compass.

SETTING BAND FOR STONES.—Charles Betsch, New York City. This improvement provides a setting especially adapted for imitation stones or brilliants, by which the stones will be held more firmly than when attached in the ordinary manner, and the settings will not be separated from the bands. The band has spurs or pins projecting from it, and a stone setting riveted to it by means of the pins.

MATTRESS FORMER AND PRESS.—William G. Stuart and Charles H. Delp, Scottsborough, Ala. A box-shaped former has been devised by these inventors, with the ends of the former pivotally connected to its sides, and in connection with which are used longitudinal and transverse dividing boards and pressing strips for binding the mattress after it has been shaped. The device can be easily and quickly adjusted to suit any size which it is desired to make a mattress, and the press is so made that the body of the mattress can be easily inserted into the tick after it has been formed.

FLY TRAP.—William A. Hill, Saluda Old Town, S. C. This invention relates to that form of trap in which an endless belt, carried over rollers and driven by clock gearing, is arranged in a frame and baited with molasses or sweetened water to carry the flies under a cage in which they are imprisoned. The improvement provides a very simple, cheap and efficient trap of this description.

GAME BOARD.—Charles W. Fishel, Aspen, Col. This board has cushioned walls at the sides and one end, pockets in the cushions and cupped in the central portion, and a semicircular head wall and sloped platform on one end, where also a swiveling and rocking ball-propelling device is located. The game consists in propelling the balls so they will roll into the different pockets, which have varying values.

ENDOGRAPH.—Frank W. Haviland, New York City. This invention provides an instrument for the treatment of the uterus, one which will follow the wall of the uterine cavity and of the cervical canal and automatically produce a diagram, illustrating the angles and their length and the shape of the cavity. The instrument can be readily taken apart and thoroughly cleaned.

A flexometer, for which another patent has been issued to the same inventor, affords means whereby the degree of deflection of the uterus may be accurately determined.

NOTE.—Copies of any of the above patents will be furnished by Munn & Co., for 25 cents each. Please send name of the patentee, title of invention, and date of this paper.

NEW BOOKS AND PUBLICATIONS.

A MANUAL OF PRACTICAL ASSAYING. By H. Van F. Furman. First edition. New York: John Wiley & Sons. 1893. Pp. vi, 390. Price $3.

The subject of assaying, which of late years has acquired increased interest, in this book receives a much fuller treatment than is usually awarded to it. The size of the book and its number of pages indicate the thoroughness of the treatment. The walls erected between assaying and analysis are every year being broken down, so that we find the present work toward the end drifting into proper analytical work, but throughout the finer methods of chemistry are unhesitatingly adopted, where required for accuracy. It is divided into four parts; the first part introductory, giving the general systems of sampling and other manipulations; the second part devoted to the determination of special things, principally the metals. The third part is devoted to special assays and analyses, such as bullion, copper matte, silver and gold, ores of various kinds, amalgam, coal and coke, white lead, aluminum, natural phosphates, etc. In the fourth part are given chemical equations, stoichiometry or the arithmetic of chemistry, the subject perhaps neglected by the superficial worker, and the calculation of lead blast furnace charges. This last portion is worked out very elaborately, the cost of charges being accurately calculated. An excellent selection of tables closes the book, which is effectively indexed and illustrated as required.

THE MECHANICS OF HOISTING MACHINERY, INCLUDING ACCUMULATORS, EXCAVATORS, AND PILE DRIVERS. A TEXT BOOK FOR TECHNICAL SCHOOLS AND A GUIDE FOR PRACTICAL ENGINEERS By Dr. Julius Weisbach and Prof. Gustav Herrmann. London and New York: Macmillan & Co. 1893. Pp. viii, 332. With 177 illustrations. Price $3.75.

Translations from the works of Weisbach are always to be welcomed. His thoroughness of treatment and satisfactory formulæ make his work exceedingly acceptable to engineers. The subject of hoisting and dredging machinery has, of late years, acquired such importance that

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a monograph on the subject is timely and will meet with full appreciation. Levers, tackle, windlasses, hydraulic machinery, cranes and shears, excavators and dredges and pile drivers are samples of the subjects included in this work. German like, the author starts from the simplest types of machinery—levers and jacks—and goes up to the most complicated machinery in use by modern engineers. Formulæ and the resolution of force are applied wherever needed to elucidate the action of the machinery. The illustrations are very well executed and leave nothing to be desired.

THE ART OF PRESERVING HEALTH. Outlines of practical hygiene adapted to American conditions. By C. Gilman Currier, M D. 1893. New York: E. B. Treat. Pp. 468. Price $1.75.

The contents of this work indicate a very full scope. Nothing appertaining to practical hygiene seems foreign to it. Ventilation, food, water, plumbing and sewage, diseases, bacteriology, infection and disinfection are among the topics which it treats. Each topic involves a branching out into allied subjects. so that nothing is left to be desired as regards range. The author's treatment of the subject seems judicious, as he does not seem to be carried away by any fads and his recommendations seem dictated by common sense. As an example of the details of the treatment, the arsenic found in some of the kindergarten papers and in certain bed ticking is spoken of, a detail indicating that the author has done his best to thoroughly and adequately cover his subject.

Beautiful Calendar.—Messrs. Styles & Cash, ornamental printers and stationers, corner of Fourteenth Street and Eighth Avenue, New York, issue every year very handsome calendars, which they present to their customers and friends on the first of January with their greetings. This year's issue does not lack the merit of their previous productions.

The "Columbia" desk calendar of the Pope Manufacturing Company is received. It is a pad calendar having space for memoranda for each day of the year, but a portion of each day's leaflet tells something of the advantages of bicycles, and especially of the well known Columbia wheel. The Columbia was among the very first in the field as a good wheel of American manufacture, and it has always held its place.

☞Any of the above books may be purchased through this office. Send for new book catalogue just published. MUNN & Co., 361 Broadway, New York.

SCIENTIFIC AMERICAN BUILDING EDITION.

JANUARY, 1894.—(No. 99.)

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1. Elegant plate in colors showing a suburban dwelling at Bridgeport, Conn., recently erected for L. D. Plumb, Esq., at a cost of $4,500 complete. Floor plans and perspective elevation. An excellent design. Mr. C. T. Beardsley, architect, Bridgeport, Conn.
2. Plate in colors showing the residence of Thomas C. Wordin, Esq., at Bridgeport, Conn. Two perspective views and floor plans. Cost $3,600 complete. Mr. Joseph W. Northrop, architect, Bridgeport, Conn.
3. A colonial dwelling erected for Philip Lucas, Esq., at Mount Vernon, N. Y. Perspective and floor plans. An excellent design. Cost $7,000 complete. Mr. Louis H. Lucas, architect, Mount Vernon, N. Y.
4. A cottage at Cranford, N. J., erected at a cost of $5,000. Floor plans, perspective view, etc.
5. Engravings and floor plans of a suburban residence erected at Brookline, Mass. Mr. E. L. Rodgers, architect, Boston, Mass. A very attractive design.
6. A dwelling recently erected at Elizabeth, N. J., at a cost of $5,500. Floor plans and perspective elevation. Mr. J. E. Baker, architect, Newark, N. J.
7. A new frame schoolhouse at Elizabeth, N. J., erected at a cost of $16,000 complete. Elevation and floor plans. Messrs. Charlock & Howard, Elizabeth, N. J., architects.
8. A dwelling recently erected for W. E. Clow, Esq., at Buenna Park, Chicago, Ill. A picturesque design. Two perspective views and floor plans. Mr. Greg Vigeant, architect, Chicago.
9. A town library of moderate cost at Colchester, England. Perspective view and plans.
10. A house at Cambridge, Mass., erected at a cost of $6,000. Mr. J. T. Kelly, Boston, architect. Perspective and floor plans.
11. Restoration of the Pantheon at Rome. Half page engraving.
12. Miscellaneous Contents: A rival to oak.—Seaside painting.—Miscellaneous weights.—Water tanks.—Improve your property.—Cement.—Peruvian ruins.—Ornamental iron and brass work, illustrated.—Facts for builders.—The Goetz box anchors, post caps, and hangers, illustrated.—Improved gasgrate, illustrated.—Improved drawing instruments, illustrated.—Climax gas machine, illustrated.—Improved square chisel, mortiser, and borer, illustrated.—Adamant brush finish.—Patent stair gauge, illustrated.

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The new material, "Linenoid," Westfield, Mass.

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Stave machinery. Trevor Mfg. Co., Lockport, N. Y.

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Improved iron planers. W. A. Wilson, Rochester, N.Y.

Microbe Killer Water Filter, McConnell Filter Co., Buffalo, N. Y.

Pipe frame truck baskets, steel and wooden trucks, etc. L. M. Moore, Rochester, N. Y. See page 399.

Steam Hammers, Improved Hydraulic Jacks, and Tube Expanders. R. Dudgeon, 24 Columbia St., New York.

Screw machines, milling machines, and drill presses. The Garvin Mach. Co., Laight and Canal Sts., New York.

Centrifugal Pumps. Capacity, 100 to 40,000 gals. per minute. All sizes in stock. Irvin Van Wie, Syracuse, N.Y.

For Sale—Patent No. 434,679, for washing milk cans. No patent sharps need apply. B. R. Rapp, West Chester, Pa.

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The best book for electricians and beginners in electricity is "Experimental Science," by Geo. M. Hopkins. By mail, $4; Munn & Co., publishers, 361 Broadway, N. Y.

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Patent Electric Vise. What is claimed, is time saving. No turning of handle to bring jaws to the work, simply one sliding movement. Capital Mach. Tool Co., Auburn, N. Y.

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Notes & Queries

HINTS TO CORRESPONDENTS.

Names and Address must accompany all letters, or no attention will be paid thereto. This is for our information and not for publication.

References to former articles or answers should give date of paper and page or number of question.

Inquiries not answered in reasonable time should be repeated; correspondents will bear in mind that some answers require not a little research, and, though we endeavor to reply to all either by letter or in this department, each must take his turn.

Buyers wishing to purchase any article not advertised in our columns will be furnished with addresses of houses manufacturing or carrying the same.

Special Written Information on matters of personal rather than general interest cannot be expected without remuneration.

Scientific American Supplements referred to may be had at the office. Price 10 cents each.

Books referred to promptly supplied on receipt of price.

Minerals sent for examination should be distinctly marked or labeled.

(5699) H. C. writes: I have a two cell electroplating battery. When I want to plate a wax matrix I am unable, after brushing same with black lead, to make it a conductor. I wish to electrotype on a small scale and would like to have these questions answered: 1. The batteries are common telegraph (zinc, copper and blue vitriol). Will such batteries (two in number) furnish a current sufficient? How can I increase the current? How can I make a wax matrix a conductor? A. After the black lead has been applied sprinkle iron dust on your wax. This will start the plating. Your batteries cannot have their current increased beyond a certain point, determined by their internal resistance. In parallel ½ ampere is about all they will give and in series about ⅛ ampere. They will give current enough for small work. 2. About what proportion of sulphuric acid should plating vat contain? A. About 5 per cent by weight. Consult our SUPPLEMENT, No. 310, for particulars as to electroplating.

(5700) J. F. writes: 1. I have a magneto machine that was used on a telephone circuit. Will you please tell me whether I can use it to run a small model of an electric motor? A. Not if of the ordinary alternating current type. 2. I have an electric motor of 1-16 horse power. Can you please tell me what power will be required to run it and get the full power out of it? A. 1-16 horse power or a little more. The volts required should be marked on the machine.

(5701) A. W. writes: 1. In SCIENTIFIC AMERICAN of October 28, Notes and Queries, No. 5442, you say a 14 inch wheel, 26 pitch, but do not mention number of blades; please do so, as I do not know the kind of wheel to get until then? A. Use a three-bladed screw. 2. I am making an Edison pattern dynamo of following dimensions: Fields 2½ inches long by 1 3-16 diameter, with twelve layers of No. 24 wire on each, 12 ounces on both; field pieces are 3 inches long, bored for 1¼ armature diameter. What number of wire, number layers, number convolutions, and 12 commutator bars is proper for the armature? A. Your armature should have 20 ohms resistance. This would be given by No. 30 wire wound in three layers, giving about 1,300 convolutions. The dynamo would have a capacity of 0·4 ampere. This is for series winding.

(5702) W. R. L. asks: In microphone transmitters there seems to be a great diversity of opinion as to the why. Some say it is the variable pressure, others the movable contact, or the heat generated, etc. What is the most probable theory? Some use large contact surfaces, while others use mere points. Which is the best, or are they both best according to the manner of use? A. Variations in resistance, due to more or less contact between the surfaces, is the "why" of it. This greater or less contact may be brought about by greater or less pressure or greater or less areas of contact. Absolute separation produces jarring sounds. Your last surmise is about correct, though larger surfaces are now preferred.

(5703) G. F. H. writes: 1. What is the reason that in an incandescent electric lamp of 50 volts you unscrew the globe and touch the standard of two of them, the shock does not feel as strong as in a common 2 volt cell battery? Sometimes the current cannot be felt at all in the incandescent lamp. A. If you touch the similar poles or terminals, there will be little shock unless a ground exists. If opposite poles, the shock may be severe, and in case of an alternating current system, any touch may be fatal. The standard proper is insulated from the wire and should give no shock. 2. Why is it that by wetting your fingers you can get more of a shock than by using dry fingers? A. It improves the electrical contact. We strongly advise you not to touch any terminal, as it may produce instant death.

(5704) V. G. A. asks what Chatterton's compound is. A. Chatterton's compound is made of—

Stockholm tar	1 part.
Resin	1 part.
Gutta percha	3 parts.

Address any dealer in electrical supplies if you wish to buy it.

(5705) F. J. T. asks: 1. What is the depolarizer used in bichromate batteries? A. The chromic acid of the alkaline bichromate. 2. How can I find tables for winding motors, etc., to get fractional parts of, and horse power? Also resistances, so as to wind electro-magnets, etc.? I have "Experimental Science," but cannot find what I want. A. These have to be calculated. Examples of dynamo and magnet calculations are contained in Sloane's "Arithmetic of Electricity," $1 by mail. 3. How can I find how to make a small gasoline engine? A. We can only refer you to books, but it is doubtful if you can build one from books alone. We recommend and can supply you with the following books relating especially to the subject you refer to: Robinson's "Treatise on Gas and Petroleum Engines," price $5.50; also Clerk's "Treatise on the Gas Engine," price $2 mailed.

(5706) S. S. D. says: Will you please tell me how to make a good composition for printers' rollers?

A.

Best glue	10½ lb.
Black molasses or honey	2½ gal.
India rubber, dissolved in oil of turpentine	1 lb.
Venice turpentine	2 oz.
Glycerine	12 oz.
Vinegar	4 oz.

The above formula is given for the mysterious black composition, so durable and elastic, and known but to very few persons until recently. Purified India rubber only is used. To recast add 20 per cent new material. The common receipt for printers rollers is 2 pounds best glue, soaked over night, to 1 gallon New Orleans molasses. Will not recast.

(5707) G. F. T. asks (1) how to make a good solder for mending tinware, one that does not require acid to solder with if possible. One that will solder sheet iron. A. An alloy made of 4 parts tin, 2 parts lead, 1 part bismuth, makes an easy-running solder for soldering with an alcohol lamp. Tinned articles can be soldered without acid, but untinned articles as sheet iron must be made clean and tinners' acid used. 2. Can you tell me how to make ordinary glass vials untransparent entirely? A fluid to wash them in I would like to know of. A. The fluid hydrofluoric acid is used for making gas translucent, the fumes answering the same purpose; it is a most dangerous poison and is not recommended for use by amateurs. Coarse emery shaken in the bottle with buckshot, or the outside of the bottle inclosed in a box with emery and shot and well shaken, will produce the desired effect.

(5708) L. S. F. asks: Practically, how close to the wind can a first class yacht sail? That is, what is the minimum angle between the yacht's path and the direction of the wind, allowance being made for leeway? A. Much depends upon the model and trim of sails, in the ability of yachts to sail close to the eye of the wind. Fine lines and flat sheets may carry a yacht up to two points of the wind, say 22 degrees off, but a large class cannot sail nearer than 3 points or 33 degrees.

(5709) L. E. R. asks: 1. Is there any known substance that will dissolve carbide of silver? A. If such a compound were produced, it would probably dissolve with decomposition in nitric acid. 2. How may one change a formula written in parts, where liquids as well as solids are in parts, to apothecaries' fluid measure, also dry? A. Parts generally mean parts by weight. Substitute in the solid parts grains or other units, and for the liquids equivalents in liquid measure, having regard to the specific gravity of the fluids. Tables of equivalents are given in the text books.

(5710) G. L. R. asks: Please answer in your Notes and Queries (1) how the compass is kept from being attracted by the mass of steel around on the man-of-war? A. Special constructions of compass are made, shielded from the influence of the ship. 2. I have 6 cells of the Daniell's battery, copper on the outside of the porous cup in blue vitriol and water, and zinc on the inside of the porous cup in salt and water; please tell me what the copper color substance is that forms on the outside of the porous cup and how I can remove it without taking pieces out of the cup when I try to remove the substance. A. It is metallic copper. You can remove it by dissolving in nitric acid. It may be cheaper to get a new cup.

(5711) M. S. P. asks: How many cells of storage battery are required to run the electric motor described in SUPPLEMENT, No. 641, also the number and size of the plates in each cell of storage battery? The number of cells of gravity battery required to charge the storage battery, and the time required to charge the same? A. Two cells, each having one square foot of positive plate. To charge slowly, 5 gravity cells will answer. By using parallel series of 5 gravity cells the charging can be accelerated. We advise not less than 20 gravity cells in 4 series of 5 each.

(5712) H. O. G. asks: What will clean a boiler of lime where you carry 15 pounds of steam to heat a building without injuring the boiler? A. Charge the boiler through the feed with a half pound of caustic soda for each nominal horse power, through the feed or in any convenient way. Use the boiler a week and then clean out thoroughly. If there is means for blowing off the boiler, a less quantity used at stated intervals, and the water partially blown out, will keep the boiler in good condition.

(5713) N. A. W. asks: It is quite generally known that carbonic acid gas is deathly poisonous, and we are also told that carbonic acid gas gives the palatable, sparkling, and exhilarating taste to champagne, beer, etc. If one is poisonous and the other healthful, why should the two gases have the same name? A. Carbonic acid gas if inhaled tends to asphyxiate or drown by exclusion of air. It is possible that it also has a poisonous effect when drawn into the lungs. In drinking champagne very little or none of the gas gets to the lungs, and its presence in the wine does not interfere with respiration. A lung poison is not necessarily a stomach poison. The gas is the same—there are not two gases of the same name.

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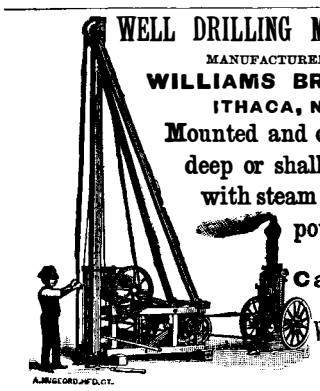

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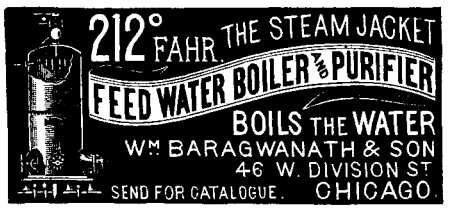

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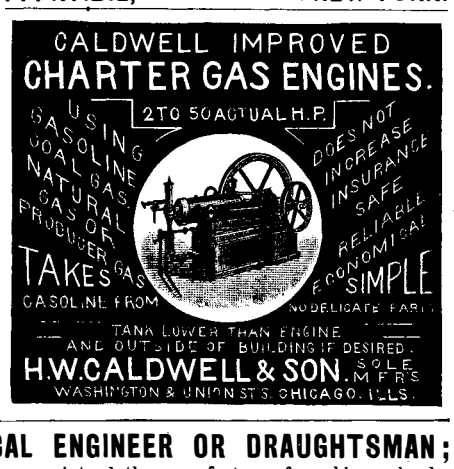
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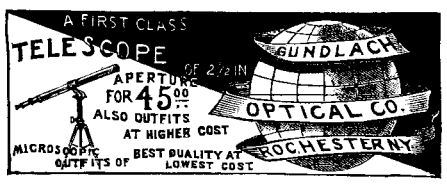

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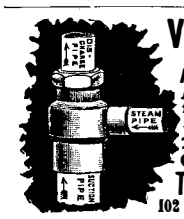

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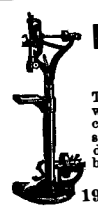

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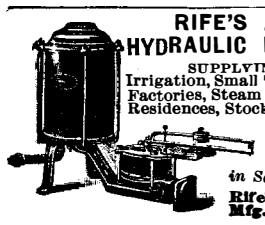

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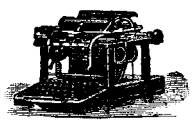

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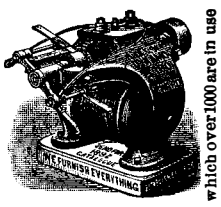

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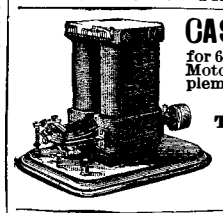

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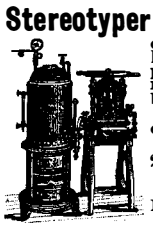

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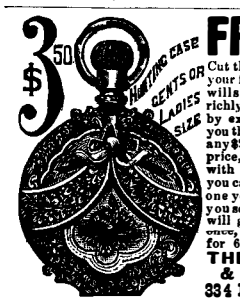

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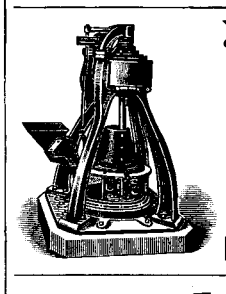

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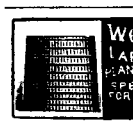

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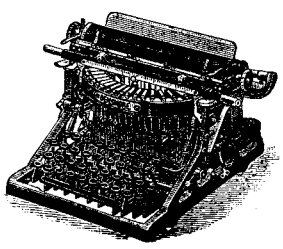

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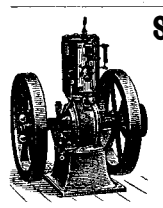

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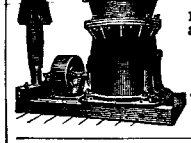

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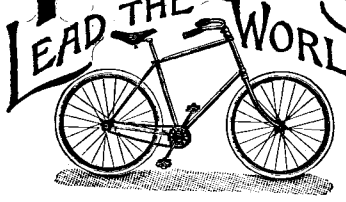

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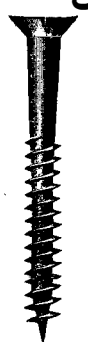

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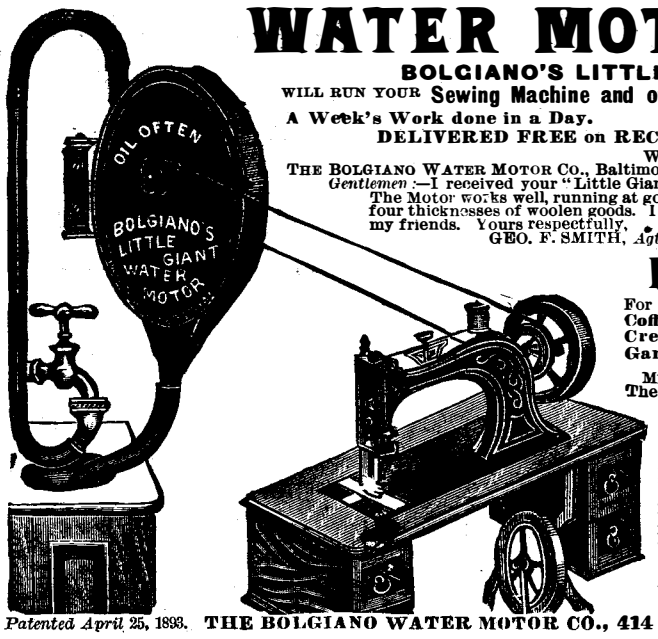

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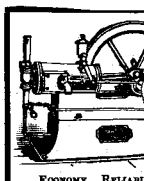

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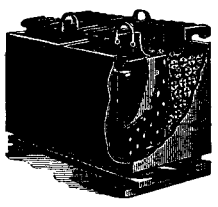

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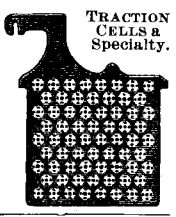

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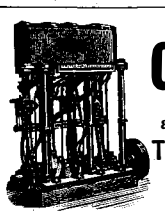

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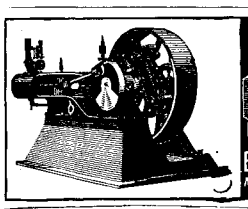

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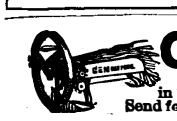

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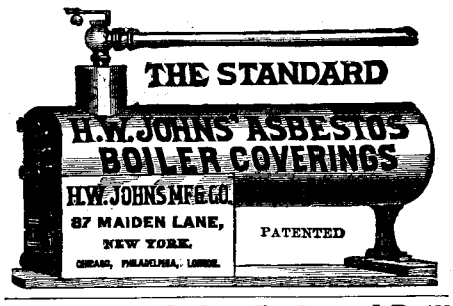

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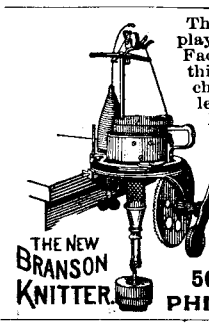

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